AuvTool User's Guide

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Contents

1.0 INTRODUCTION

1.1 What is AuvTool?

AuvTool is a software tool for statistical analysis of variability and uncertainty associated with fitting parametric probability distributions to data sets. It was developed for the Office of Research and Development (ORD) of U.S. Environmental Protection Agency, Research Triangle Park, NC.

A technical report was written for this project, with a focus on the methods and algorithms used in the AuvTool software. The technical report contains a review of probabilistic analysis with detailed presentation of the methods used in the AuvTool software for fitting distributions to data, uncertainty analysis, and criteria for automatically selecting a best distribution model in the batch analysis. The technical report also contains a case study similar to that shown here in the User's Guide, and it contains results of QA/AC tests. The technical report is:

Frey, H.C., J. Zheng, Y. Zhao, S. Li., Y., Zhu, *Technical Documentation of the AuvTool Software Tool for Analysis of Variability and Uncertainty*, Prepared by North Carolina State University for the U.S. Environmental Protection Agency, Research Triangle Park, NC. February, 2002

The technical report and user's guide are also available in the AuvTool software package.

1.2 Purpose

The purpose of this project is to develop, evaluate, and refine a user-friendly module for the EPA Stochastic Human Exposure Dose Simulation (SHEDS) model. The module incorporates appropriate algorithms for assigning or fitting statistical

distributions to model inputs for quantifying variability in the data, and features the use of bootstrap simulation for quantifying uncertainty in statistics for the data or fitted distributions. However, as a stand-alone tool, AuvTool is also generally applicable to quantifying variability and uncertainty in risk assessment, emissions estimation, and other quantitative analysis fields.

1.3 System Requirements

The AuvTool software requires the following configurations:

- The Intel-based computer running Windows 98/Me.
- Any SVGA (or better) display—at least a resolution of 800x600 (or more) pixels; a resolution of 1024x768 is recommended.
- At least 100 Megabytes of free hard disk space.
- At least 64 Megabytes of total memory.

1.4 Software Tools Used in Development of AuvTool

The underlying algorithms, simulation models, and Graphical User Interface (GUI) were written in Microsoft® Visual C++ 6.0, a standard software development tool for the Windows environment. The GUI eliminates the need to master the underlying commands normally required in the DOS environment. Graphic Control Server 5.0A provides graphic presentation of calculation results. Far Point Spread 3.0 provides a spreadsheet for data entry and outputs of results.

Visual C++ runtime libraries, and the dynamic link libraries and runtime libraries of Graphic Control Server 5.0A and Spread 3.0, are included with the AuvTool installation package and do not need to be licensed separately.

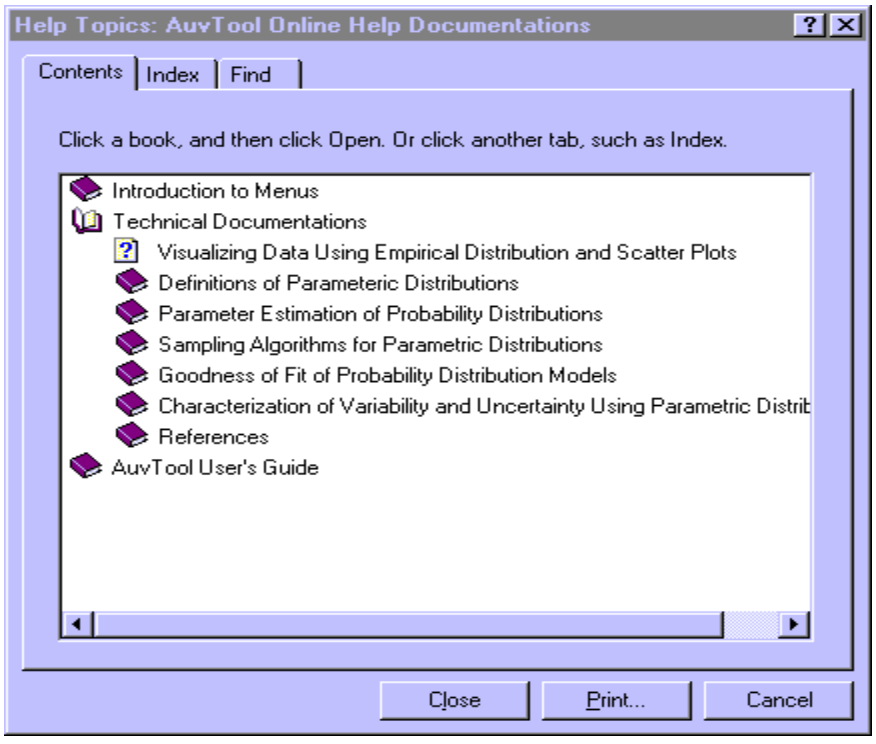
1.5 Using Online Help Documentation

The online help provides an online version of this *User's Guide* and of the *Technical Documentation for Analysis of Variability and Uncertainty for the AuvTool Software* via a Windows Help System.

You can access the AuvTool help files by doing any one of the following when you are running AuvTool:

- Press **F1** key.
- Pull down the **Help** menu at the top of the AuvTool window, select **Help Topics.**
- Click the **Help Topics** on the toolbar on the left side of the AuvTool Window.

The AuvTool Help File System will display.



The AuvTool Online Help Documentation Window

1.6 Disclaimer of Warranties and Limitation of Liabilities

This report was prepared by the Computational Laboratory for Energy, Air and Risk, located in the Department of Civil Engineering at North Carolina State University as an account of work sponsored by the U. S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, NC under contract No. ID-S794-NTEX

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1.7 Copyright Notices

2.0 INSTALLING AuvTool

2.1 What is Included in the Installation Package

The AuvTool installation package contains the following items:

- **Installation CD-ROM:** All the software is on the CD-ROM in compressed form. An installation program included on the CD-ROM will install the necessary files automatically. See "Installation" below for instructions.
- **Two pieces of documentation:** *User's Guide*, and *Technical Report.* These are included as Adobe PDF documents on the installation disk, and can be opened or copied to another disk.

2.2 Installation

To install the AuvTool program, you must use the installation program, SETUP.EXE, provided on the installation CD-ROM. Simply copying the contents of the CD-ROM to your hard drive will **not** work because the programs are on the CD-ROM in compressed form. Program files must be decompressed and installed in the appropriate directories to run properly. Copying the contents of the distribution CD-ROM to a local hard drive can speed up the installation process.

To run the Setup Program

1. Place the A CD-ROM in your CD-ROM drive;
2. Click the **Start** button;
3. Choose **Run…** from the Start menu; and

4. Type "X:\ XXX\" SETUP.EXE" where "X:\ " is the drive and directory to which you copied the installation files.

The Installation Program will begin. Follow the instructions on the screen.

You also can install AuvTool as follows:

1. Place the AuvTool CD-ROM in the CD-ROM drive;

2. Double-click the **My Computer** icon on the desktop;

3. Double-click the CD-ROM drive in the **My Computer** window; and

4. Double-click the "SETUP.EXE" on the CD-ROM.

The Installation Program will begin. Follow the instructions on the screen.

2.3 Removing AuvTool

To remove the AuvTool software completely, use the uninstall feature of the Windows 98/Me "Add/Remove Software" in the **Control Panel**.

Note: Do not delete the files in the AuvTool directory. Although you may disable the program, it will not completely uninstall the program, because there are files elsewhere on your system that should also be cleaned up.

To Run the Uninstall Program

1. Click the **Start** button.

2. Choose **Settings**, and then **Control Panel.**

3. Double-click **Add/Remove Programs** in the **Control Panel** folder.

4. Highlight **AuvTool** on the list of installed software.

5. Click the **Add/Remove…** button.

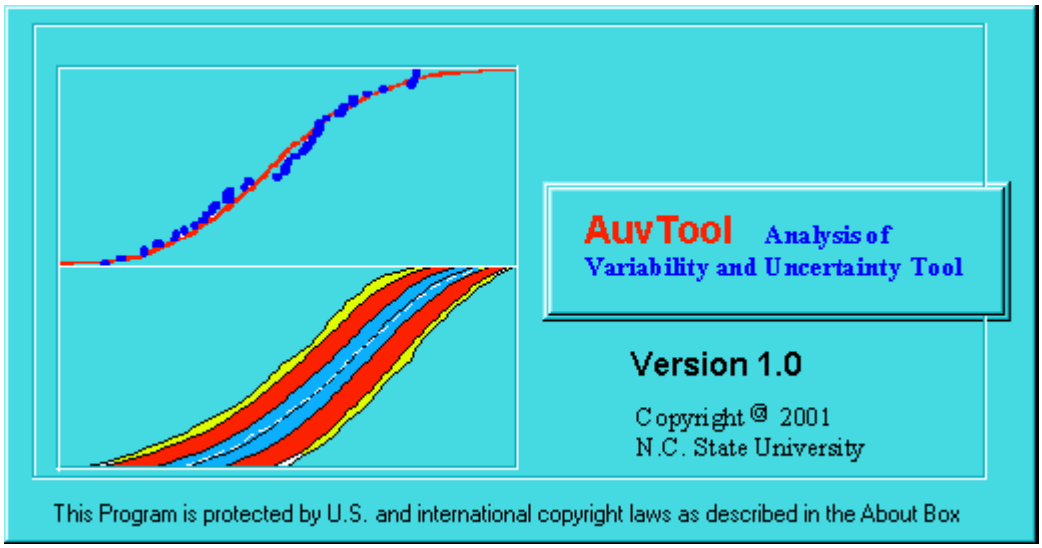
Follow the instructions on the screen.

3.0 GETTING STARTED

3.1 Starting AuvTool

A program group called AuvTool is created when the software is installed. "AuvTool" will be displayed in the **Programs** group in the Start Menu. To start the AuvTool program, click on the AuvTool program icon in the Start Menu.

The program will launch, and a picture will be displayed. The display is as follows:

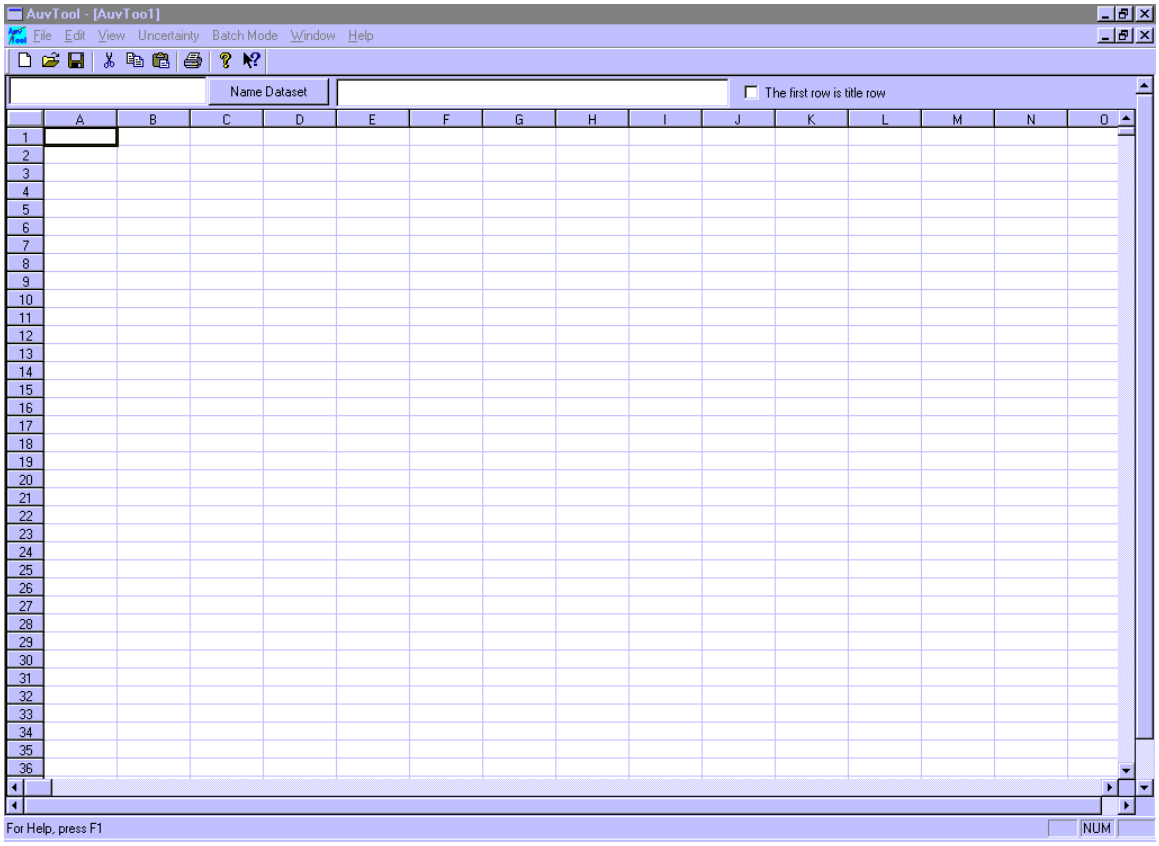


The picture will disappear in 2 seconds, after which the AuvTool mainframe window will appear and the program will be ready for use.

3.2 Using AuvTool

These are the steps or options involved in running AuvTool:

- Start AuvTool (See "Getting Started " on page 8).
- Data Entry, Importing and Exporting (see page 22).
- Random Number Generators (see page 30).
- Random Seed Setting (see page 34).



AuvTool *Mainframe and Main Sheet*

- Characterization of Variability: Fitting Distributions Dataset by Dataset (see page 36).
- Characterization of Variability and Uncertainty: Fitting Distributions by Batch Analysis (see page 44).
- Load Distribution Information without Original Data (see page 57).
- Uncertainty Analysis: Bootstrap Simulation (see page 63).
- Fitting Distributions to the Sampling Data of the Statistics of Interests (see page 72).
- Variability Analysis Result Reporting (see page 79).
- Uncertainty Analysis Result Reporting (see page 84).

- Working with a Graph (if desired) (see “ Working with Graph ” on page 100).
- Working with a Sheet (if desired) (see “ Working with Sheet ” on page 96).
- Exit AuvTool (see “ Exiting AuvTool ” on this page).

3.3 Exiting AuvTool

To exit AuvTool, do one of the following:

- Pull down the **File** pull down menu or press **Alt-F** and select **Exit**;
- Click the **Close** button (**x)** in the upper right hand corner of the AuvTool mainframe window; or
- Press **Alt-F4**.

4.0 INTRODUCTION TO AUVTOOL MAINFRAME MENUS

In this section, we will give a brief introduction to the AuvTool Mainframe Menu Commands.

4.1 File Menu

File | New (Ctrl+N)

This command creates a new data sheet window with the default name "AuvToo1." AuvTool prompts you to name an "AuvTool" file when you save it.

File | Open (Ctrl+O)

This displays a standard ***Open File*** dialog box with the default file search extension " *.ss3." You can use this command to open an existing data file saved by AuvTool.

The following options allow you to specify which file to open:

File Name
Type or select the filename you want to open. This box lists files with the extension you select in the ***List Files of Type*** box.

List Files of Type
Select the type of file you want to open: "*.ss3"

Drives
Select the drive in which AuvTool stores the file that you want to open.

Directories
Select the directory in which AuvTool stores the file that you want to open.

Once you have typed a proper filename in the ***File Name*** edit box, choose the OK to open the file you specified.

Note: Before you open an existing file, you need to first open an empty sheet by clicking the **File | New** command.

File | Close

This command lets you close the current active datasheet.

File | Import Excel…

The File | Import Excel menu item displays an ***Open File*** dialog box with the default file search extension "*.xls." You can use this command to open an existing Microsoft Excel ™ 97 file format data. You should specify a file to open by clicking on it or inputting the file name.

File | Import Tab-Delimited …

The File | Import Tab-Delimited menu item displays an ***Open File*** dialog box with the default file search extension "*.txt." You can use this command to open a data file which is saved with with tab delimiters between numbers. You should specify a file to import by clicking on it or inputting the file name.

File | Save (Ctrl+S)

This command saves the data in the active data sheet to disk.

File | Save As

This command lets you save the active data sheet to a different name, in a different directory or on a different drive. When you choose this command, the ***Save File As*** dialog box is displayed. This ***Save File As*** dialog box is similar to the ***Open Sheet*** dialog box. You can enter the new name, optionally with drive and directory, and click the Save button to accept the dialog box input.

File | Print Preview

This command lets you see an on-screen preview of how the data sheet will appear on a printed paper.

File | Print ...

This command lets you print the active sheet data. Please make sure that a printer is properly connected to your computer and that it is turned on before you choose this command.

File | Printer Setup

This command lets you select a target printer for data sheet output. This command displays the standard Windows Print Setup dialog box that you can use to set up your printer.

File | Exit

This command exits AuvTool, removes it from memory, and returns you to the Windows environment. If you have made any changes that you have not saved, AuvTool asks you if you want to save them before exiting.

4.2 Edit Menu

The menu commands listed in the Edit Menu will apply to the AuvTool *Main Sheet*.

Edit | Cut (Ctrl+X)

The Edit | Cut command removes the selected data block from your data sheet and places the data in the Clipboard. The removed data cells are filled with blank cells. You can paste that data into any other data sheet or somewhere else by choosing the Edit |

Paste command. The data remains in the Clipboard so that you can paste the same data many times.

Edit | Copy (Ctrl+C)

The Edit | Copy command places the selected data in the Clipboardand leaves the selected data intact. You can then paste that data into any other data sheet or any other editors by choosing Edit | Paste command.

Edit | Paste (Ctrl+P)

The Edit | Paste command puts data from the Clipboard into the current data sheet at the cursor position. This action depends on what you have in the Clipboard. If the data in the Clipboard contains columns (rows), then it will paste data in columns starting at the column (row) which contains the cursor cell; if the data in the Clipboard contains only a block of data cells, then the paste action will put the data to the sheet starting at the current cursor cell. The paste action overwrites data in the data sheet. It does not insert data into the data sheet.

Edit | Delete

The Edit | Delete command works like the Edit | Clear command. It removes the selected data from the data sheet but does not place it into the Clipboard. This command also shifts the data sheet so that there are no blank cells.

Edit | Insert

This menu item has a pop-up menu (or a sub-menu) which contains two commands. These commands let you insert one blank column and one blank row.

Column
This command inserts a blank column at the current cursor column position.

Row
This command inserts a blank row at the current cursor row position.

Edit | Delete

The Edit | Delete command works like the Edit | Clear command. It removes the selected data from the data sheet but does not place it into the Clipboard. This menu item has also a pop-up menu (or a sub-menu) which contains two commands. These commands let you delete one blank column and one blank row.

Column
This command deletes a blank column at the current cursor column position.

Row
This command deletes a blank row at the current cursor row position.

This command also shifts the data sheet so that there are no blank cells

Edit | Clear

The Edit | Clear command removes the selected data from the data sheet but does not place it into the Clipboard. The removed data cells are filled with blank cells. This means that you can not paste the data as you could if you had chosen Cut or Copy commands.

4.3 View Menu

View | Toolbar

This command controls the display of toolbar within the main window frame. If checked, it will display the toolbar. If not checked, the toolbar will not be displayed.

View | Status Bar
This command controls the display of status bar within the main window frame. If checked, it will display the status bar. If not checked, the status bar will not be displayed.

4.4 Uncertainty Menu

Uncertainty | Random Seed Setting…

This command will popup a dialog which allows users to set the random setting. See "Random Seed Setting " on page 34 for more details.

Uncertainty | Random Generator…

This command will popup a dialog which allows users to generate random numbers from normal, lognormal, gamma, beta, Weibull, uniform, symmetric triangle and empirical distributions. For more details, see "Random Number Generator" on page 30.

Uncertainty | Single Distributions…

This command will popup a dialog box which allows users to estimate parameters for normal, lognormal, gamma, beta, Weibull, uniform, symmetric triangle distributions single dataset by single dataset. For more details, see "Characterization of Variability: Fitting Distribution Dataset by Dataset" on page 36.

4.5 Batch Mode Menu

Batch Mode | Load Distributions…

This command will popup a dialog which allows users to load or enter existing distribution information that users have for batch uncertainty analysis. For more details, see " Enter or Load Distribution Information "on page 57.

Batch Mode | Batch Analysis…

This command will popup a dialog which allows users to do batch variability and uncertainty analysis for their datasets. It includes: parameter estimation, bootstrap

simulation, automatic best distribution selection and so on. For more details, see "Characterization of Variability and Uncertainty: Batch Analysis" on page 44.

4.6 Window Menu

The Window menu contains window management commands. At the bottom of this menu, all currently opened child window are listed.

Window | Cascade

This command rearranges all open sheet/plot windows in overlapping layers. The title of each window is revealed so that you can see the name of the sheet/plot it contains.

Window | Tile

This command displays all open sheet/plot windows without overlapping them. When possible, the windows are all given equal room on the screen.

Window | Arrange Icon

After several open sheet/plot windows are minimized as icons in the main window, this command can quickly place the icons in neat rows along the bottom of the screen.

4.7 Help Menu

Help | Help Topics

This command will pop up AuvTool online help documentation dialog box.

Help | About AuvTool

This command will display the version information about AuvTool**.**

5.0 PROBABILITY DISTRIBUTION DEFINITIONS AND AUVTOOL CONVENTIONS

In this section, definitions of probability distributions used in the AuvTool are presented. The conventions used in the AuvTool are also introduced.

5.1 Definitions of Parametric Probability Distributions

Commonly used parametric distributions used in variability and uncertainty analysis include normal, lognormal, Weibull, gamma, beta, uniform and triangle distributions. Table 5-1 lists the definitions for the seven common parametric distributions included in AuvTool.

Table 5-1. Definitions of Probability Distribution Density Function for Parametric Distribution in Included in AuvTool

Name of Distribution	Probability Density Function (PDF)	
Normal	$f(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-(x-\mu)^2}{2\sigma^2}}$	
Lognormal	$f(x) = \frac{1}{x\sqrt{2\pi\sigma_{\ln x}{}^2}} e^{\frac{-(\ln x-\mu_{\ln x})^2}{2\sigma^2}}$	$(0 < x < \infty)$
Beta	$f(x) = \frac{x^{\alpha-1}(1-x)^{\beta-1}}{\boldsymbol{B}(\alpha,\beta)}$	$(0 \le x \le 1)$
Gamma	$f(x) = \frac{\beta^{-\alpha} x^{\beta-1} e^{-x/\beta}}{\Gamma(\alpha)}$	$(0 \le x < \infty)$
Weibull	$f(x) = \frac{c}{k}(x/k)^{c-1} \exp(-(x/k)^c)$	$(0 \le x < \infty)$
Uniform	$f(x) = \frac{1}{b-a}$	$(a \le x \le b)$
Symmetric Triangle	$f(x) = \frac{b-\lvert x-a \rvert}{b^2}$	$(a-b \le x \le a+b)$

In the Table 5-1, for the normal distribution, μ is the arithmetic mean, and σ is the arithmetic standard deviation. For the lognormal distribution μ_{lnx} is the mean of *ln(x)*, and σ_{lnx} is the standard deviation of *ln(x)*. In the beta distribution, α and β are shape parameters, and $B(\alpha, \beta)$ is the beta function. For the gamma distribution, α is the shape parameter, β is the scale parameter, and $\Gamma(\cdot)$ is the gamma function. For the Weibull distribution, *k* is the scale parameter, and *c* is the shape parameter. For the uniform distribution, *a* and *b* are the smallest and largest possible values. For the symmetric triangle distributions, *a* and *b* determine the range that a variable can vary.

5.2 Empirical Distribution

An empirical distribution can be defined as a discrete distribution, *F*, that gives equal probability, 1/n, to each value x_i in the dataset, **x** (Efron, 1979). The CDF for this function is therefore a step function of original data set, **x**, where each value x_i is assigned a cumulative probability of *i*/n for *i*= {1,2,…n}. An example of an empirical distribution represented a step function for a data set with n=10 is provided in Figure 5-1.

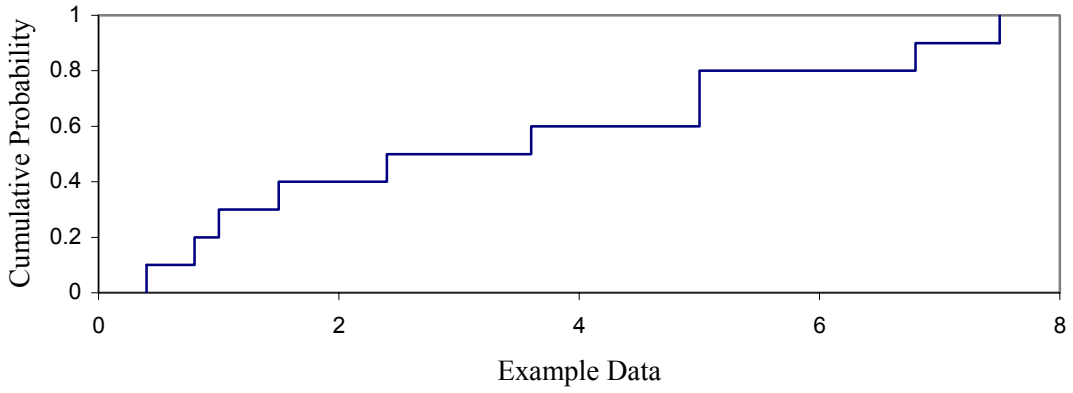


Figure 5-1. An example of an Empirical Distribution Represented a Step Function

Table 5-2. Conventions for 1st Parameter and 2nd Parameter Terms Used in AuvTool

Distribution Name	**1st Parameter**	**2nd Parameter**
Normal	Mean, μ	Standard Deviation, σ
Lognormal	Mean of ln(x), μ_{lnx}	Standard Deviation of ln(x), σ_{lnx}
Beta	Shape, α	Shape, β
Gamma	Scale, α	Shape, β
Weibull	Scale, k	Shape, c
Uniform	Minimum, a	Maximum, b
Symmetric Triangle	a	b

(Please refer to the *Technical Documentation* for detailed definitions of these distributions and other relevant information)

5.3 AuvTool Conventions

1st parameter and 2nd parameter

Each parametric distribution contained in this version of AuvTool is described by two parameters. In some modules, we use the *1st parameter and 2nd parameter* to represent the two parameters. The specific interpretation of each parameter differs for different types of parametric distributions is presented in Table 5-2.

Note: The user does not have to be familiar with the mathematical formulation of the parametric probability distribution models or with the interpretation or the values of the parameters in order to use this program.

Introduction to the Example Used in the User's Guide

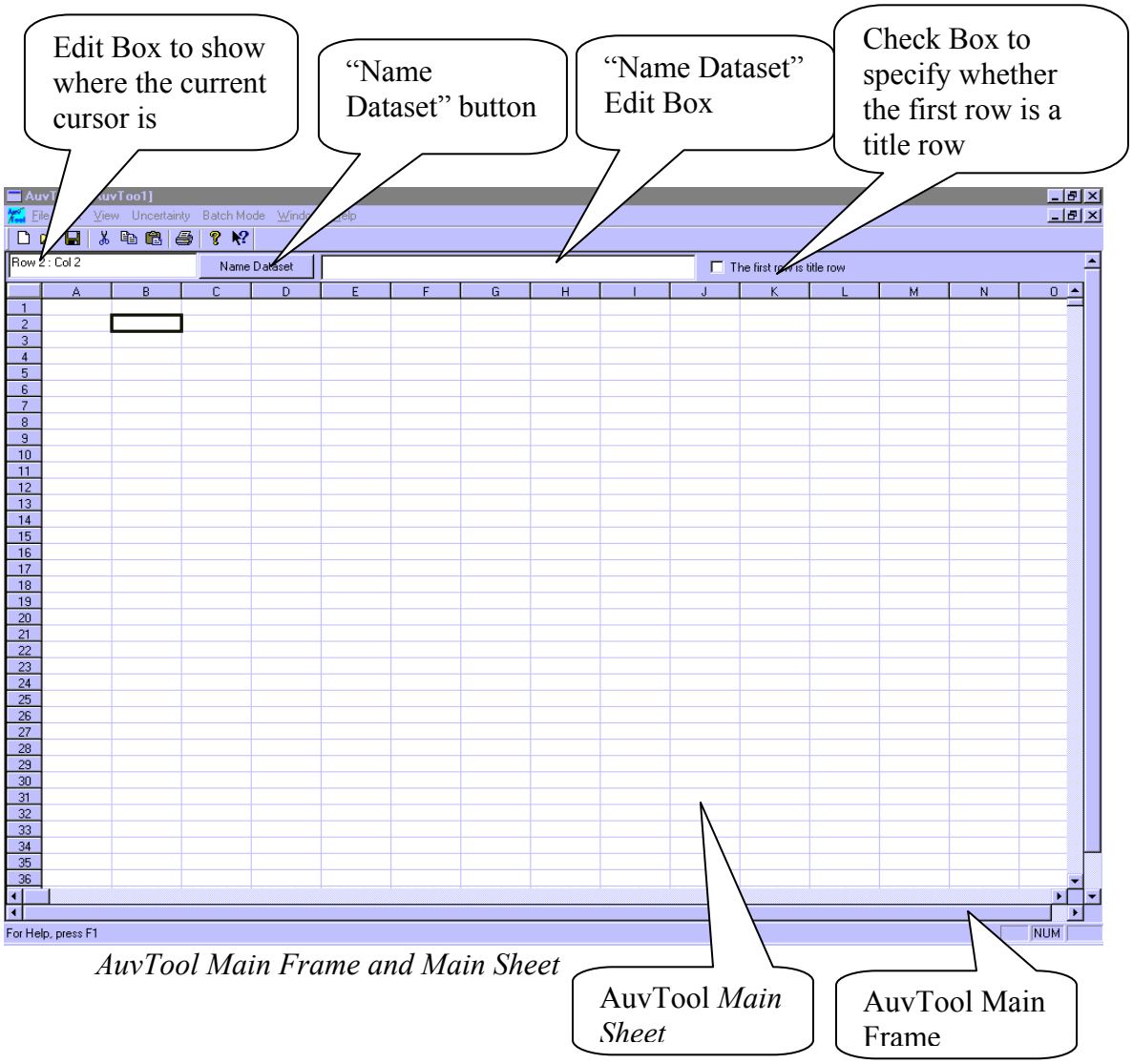
In the User's Guide, we use an example study to help describe the use of the AuvTool. The example datasets shown in the all pictures in the Guide come from the example study. In the example study, there are five datasets with original data, which are named as " Dataset 1", " Dataset 2", " Dataset 3", " Dataset 4", and " Dataset 5"

respectively; and three datasets without original data, which are named as "NoDataName 1", "NoDataName 2"and "NoDataName 3", respectively. These datasets are included in two files, which are called "ExampleWithData.ss3" and "ExampleWithoutData.ss3", repectively. The two files are contained in the installation package of AuvTool. During the process of installing AuvTool, the setup program will automatically copy the two files to the working directory of AuvTool. You can find these two files in this directory.

6.0 DATA ENTRY, IMPORTING AND EXPORTING

In this section, you will learn how to enter data in the AuvTool data *Main Sheet* for variability and uncertainty analysis and how to import or export data through AuvTool.

Before you can do any analysis using AuvTool, you must provide data to the *Main Sheet* in the AuvTool mainframe window as shown in the following:



AuvTool Main Frame and Main Sheet

After you start AuvTool, the program will provide you with a blank sheet as shown above. There are four ways to enter data. You can enter data by keyboard, load data from an existing AuvTool disk file, import data from other file formats or use the Window **copy** and **paste** command located **Edit** menu in the AuvTool *Main Frame* to enter data.

6.1 Input Data from the Keyboard

You can enter data by moving the cursor (highlighted cell) to a cell and then typing a number. Press <Enter> key to accept the input and the cursor will automatically move down one row. Repeat this step to enter the remaining data in the column. If you want to change the data in a cell, just move the cursor to the cell, type another value and press <Enter>.

Tip: You can also use arrow key to accept the value in the current active cell and move the active cell to the next cell pointed by the arrow.

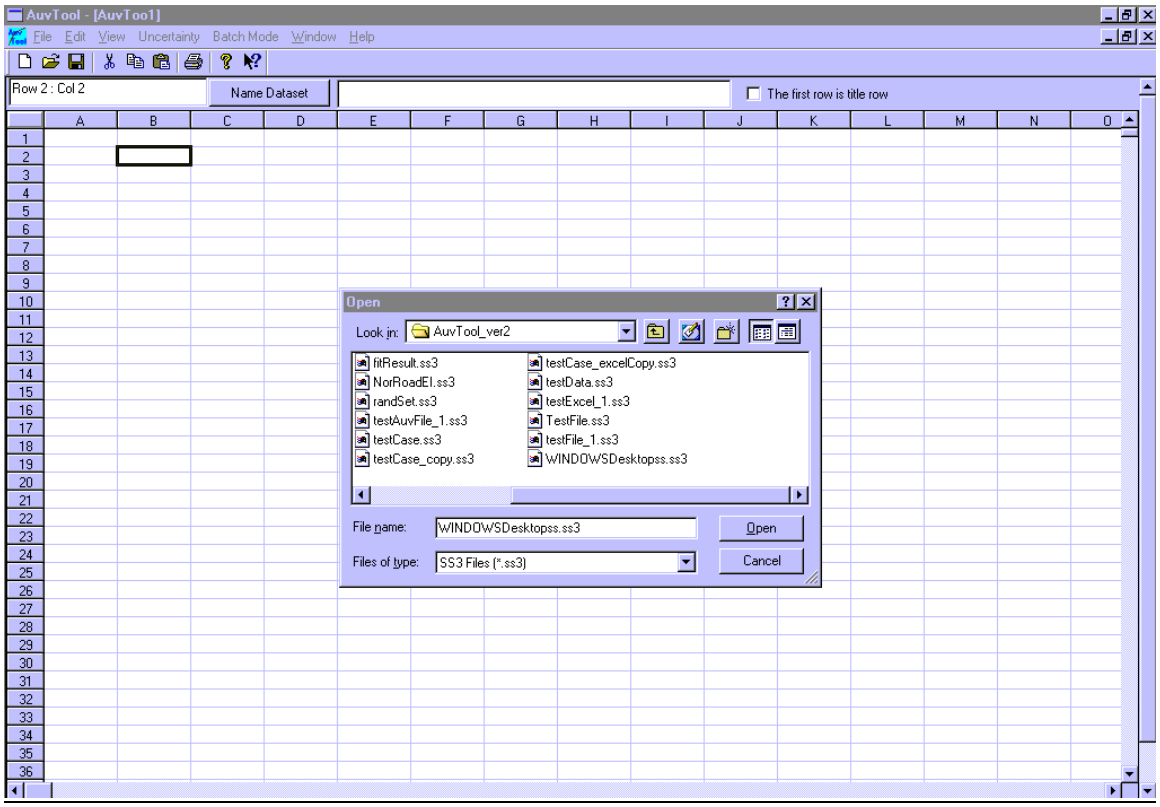
Note: In AuvTool, it is specified that each column in the *Main Sheet* represents one dataset. If you have multiple datasets, you have to enter the different datasets into different columns. You must name each dataset. You can refer to the "Naming a Dataset" section on page section 27 for how to name a dataset.

6.2 Loading AuvTool Data File

AuvTool has its own data file format with an extension of ".ss3" or ".SS3". It is in a binary format.

To open an existing AuvTool data sheet file:

- Pull down the **File** pull down menu (or press **Alt-F**) and select **Open**, or just click the **Open** icon on the tool bar. The program will display an ***Open*** file dialog box as shown below:



- Find the file name that you would like to open. Click the Open button in the *Open* dialog box.

The AuvTool main sheet will load your data. Now you can use any features that AuvTool provides.

6.3 Importing Data from Other Data File Formats

AuvTool can also exchange data with many popular data file formats such as Microsoft Excel ™ files (XLS) and Tab-Delimited files provided by any text editor. Since the AuvTool data sheet can only handle numerical value and text string (only for the first row, when used as a title of a dataset) when you import data into AuvTool, make

sure the data file contains only numerical values except for text strings that are contained in the first row or the column headers. Otherwise, the program will provide a warning message box to show you that the text in a particular cell is not a valid numerical value. You must correct all the mistakes before you can do further analysis. For more information, see "Data Input Checking" on page 31.

To import data to AuvTool from Microsoft Excel ™ files or Tab-Delimited files:

- Pull down the **File** pull down menu (or press **Alt-F**) and select **File| Import Excel…** or **File | Import Tab-Delimited File**; the program will display an ***Open*** file dialog box.
- Find the file name that you would like to open. Click the Open button in the ***Open*** dialog box.

Note: AuvTool can only support importing a 97 Microsoft Excel ™ file format. Make sure that your datasheet files are saved in the form of 97 Microsoft Excel ™ file. For some rare cases, if you find that you cannot import an Excel ™ data file, you also can use the following Window **Copy** and **Paste** features to import your data.

6.4 Windows Copy and Paste

Data can also be imported or exported by using Windows Copy and Paste command which are often listed in the **Edit** menu between the Windows application programs based on a spreedsheet such as Excel ™, Access ™, and AuvTool.

Copy

To copy data from a spreadsheet:

1. Select the cells that you want to copy.

2. Do any one of the following:

   - Pull down the **Edit** menu and select the **Copy.**
   - Click the **Copy** button on the toolbar on the left side of the AuvTool.
   - Press **Ctrl-C**

Paste

To paste data from a spreadsheet:

1. Select the cells that you want to paste data into.
2. Do any one of the following:

   - Pull down the **Edit** menu and select the **Paste.**
   - Click the **Paste** button on the toolbar on the left side of the AuvTool.
   - Press **Ctrl-V**

6.5 Exporting Data from AuvTool Main Sheet

AuvTool provides features to save the current main data sheet or to export the current datasheet to other file formats such as Microsoft Excel ™ or tab-delimited text. AuvTool also can make use of Window Copy and Paste features introduced above to export data to other application programs.

To save the current data sheet:

- Pull down the **File** pull down menu (or press **Alt-F**) and select **Save**, or **Save as**, or just click the **Save** icon on the tool bar. The program will display an ***Save as*** file dialog box.
- Enter a filename with an extension of ".ss3". Click the Save button in the ***Save as*** dialog box.

To export the current data sheet to a Microsoft Excel ™ file format:

- Pull down the **File** pull down menu (or press **Alt-F**) and select **Export Excel…**, The program will display an *Save as* file dialog box with the initial file type of ".xls".
- Enter a filename with an extension of ".xls". Click the Save button in the *Save as* dialog box.

***Note*:** In order to make sure that your data will not be lost, we recommend that you also save your current datasheets as an AuvTool file format when you export your data to a Microsoft Excel ™ file. Please also refer to the "Troubleshooting " section on page 118.

To export the current data sheet to a Tab-Delimited Text file format:

- Pull down the **File** pull down menu (or press **Alt-F**) and select **Export Tab-Delimited…**, The program will display an ***Save as*** file dialog box with the initial file type of ".txt".
- Enter a filename with an extension of ".txt". Click the Save button in the ***Save as*** dialog box.

Note: When you save a file, you can save the file to any other directory you want. Just select the drive letter and the directory you want to save to in the Directories box. You can also save the file to a floppy disk. In order to do that, just change the drive to the drive letter of your disk.

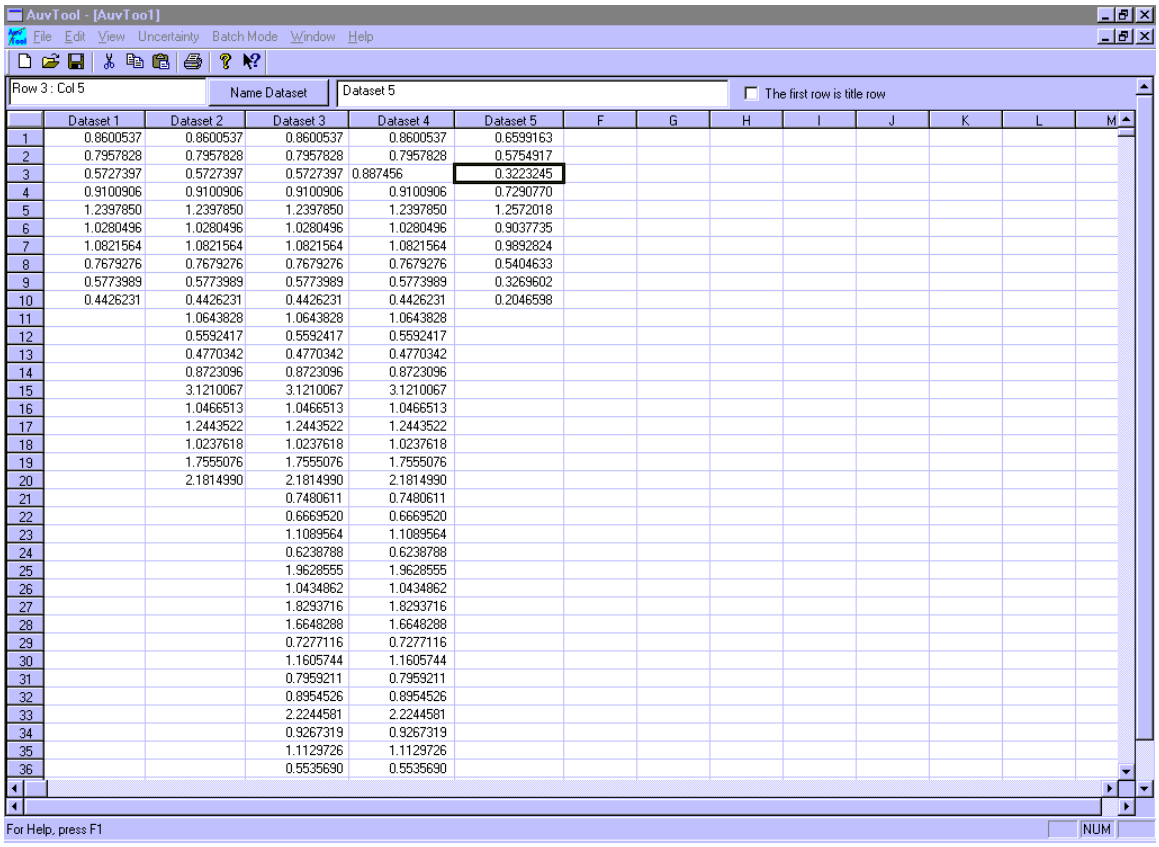
6.6 Naming a Dataset

AuvTool requires that user must name each dataset inside the AuvTool *main sheet*. As introduced above, each column stands for a dataset. The figure shown on the next page displays how the AuvTool "Name Dataset" feature works.

To name a dataset:

- Select the column where the dataset you want to name is located, or place the cursor inside any cells of the column.
- Enter names into the **Name Dataset** labeled edit box directly above the spreadsheet.

Click the Name Dataset button, and the name representing the dataset you just specified will be displayed in the header of the column.



	Dataset 1	Dataset 2	Dataset 3	Dataset 4	Dataset 5	F	G	H	I	J	K	L	M
1	0.8600537	0.8600537	0.8600537	0.8600537	0.6599163								
2	0.7957828	0.7957828	0.7957828	0.7957828	0.5754917								
3	0.5727397	0.5727397	0.5727397	0.887456	0.3223245								
4	0.9100906	0.9100906	0.9100906	0.9100906	0.7290770								
5	1.2397850	1.2397850	1.2397850	1.2397850	1.2572018								
6	1.0280496	1.0280496	1.0280496	1.0280496	0.9037735								
7	1.0821564	1.0821564	1.0821564	1.0821564	0.9892824								
8	0.7679276	0.7679276	0.7679276	0.7679276	0.5404633								
9	0.5773989	0.5773989	0.5773989	0.5773989	0.3269602								
10	0.4426231	0.4426231	0.4426231	0.4426231	0.2046598								
11		1.0643828	1.0643828	1.0643828									
12		0.5592417	0.5592417	0.5592417									
13		0.4770342	0.4770342	0.4770342									
14		0.8723096	0.8723096	0.8723096									
15		3.1210067	3.1210067	3.1210067									
16		1.0466513	1.0466513	1.0466513									
17		1.2443522	1.2443522	1.2443522									
18		1.0237618	1.0237618	1.0237618									
19		1.7555076	1.7555076	1.7555076									
20		2.1814990	2.1814990	2.1814990									
21			0.7480611	0.7480611									
22			0.6669520	0.6669520									
23			1.1089564	1.1089564									
24			0.6238788	0.6238788									
25			1.9628555	1.9628555									
26			1.0434862	1.0434862									
27			1.8293716	1.8293716									
28			1.6648288	1.6648288									
29			0.7277116	0.7277116									
30			1.1605744	1.1605744									
31			0.7959211	0.7959211									
32			0.8954526	0.8954526									
33			2.2244581	2.2244581									
34			0.9267319	0.9267319									
35			1.1129726	1.1129726									
36			0.5535690	0.5535690									

Note 1: When the titles or name of datasets are located in the headers of columns, **The first row is title row** labeled check box must be disabled.

Note 2: AuvTool does not require that the names representing different datasets in the same sheet be unique. However, for your convenience in identifying different datasets, we recommend that you use different names for different data sets.

Note 3: When the program imports data from other application programs such as from the Excel ™, sometimes, the name or titles of datasets are located in the first row. In this situation, **The first row is title row** labeled check box must be enabled by clicking on it. This check box is located immediately to the right of the text box for **Name Dataset** entry. If there are no names or titles for the imported datasets, users have to name them as introduced above.

Note 4: For any AuvTool sheet files, all of the names of all datasets within the same file are located at either the column header or the first row.

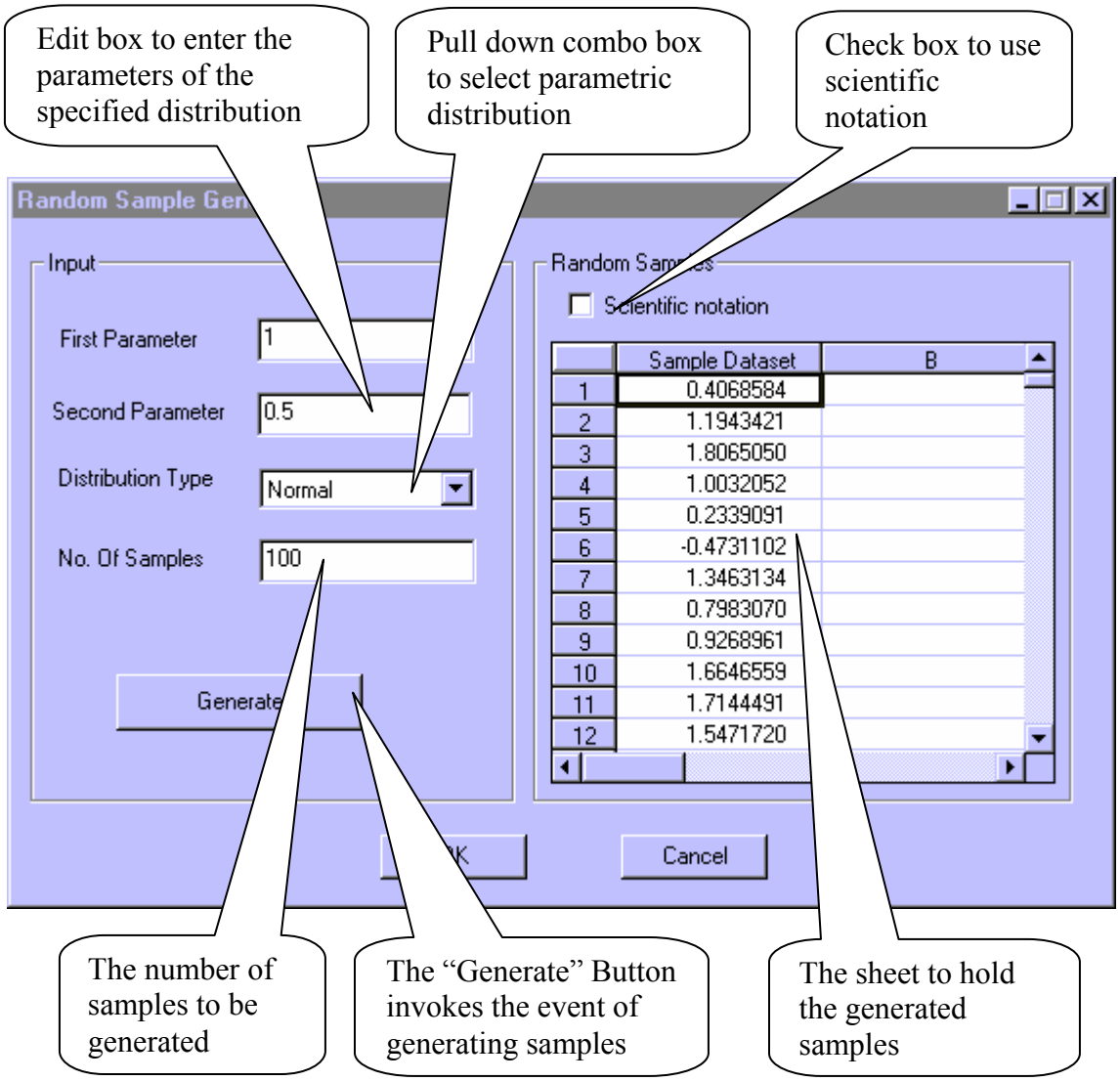
6.7 Data Input Checking

AuvTool has a feature to logically check the users' data input. AuvTool assumes that the data within any cells are valid numerical values except for the first row when the **The first row is title row** labeled check box is enabled. The feature will be invoked when users try to make further analysis. If there exists any invalid non-numerical values such as a text string in a particular cell, the program will pop up a message box showing "not a valid numerical value at row *n*, column *m*." Users must correct all the exceptions before they can do further data analysis.

7.0 RANDOM NUMBER GENERATORS

In this section, we will describe how to generate random numbers by specifying a distribution type, its parameters and the number of random samples you want to generate.

You can enter the "Random Sample Generators" module by pulling down the **Uncertainty** pull down menu and selecting **Random Generator…**. The program will display the ***Random Sample Generator*** dialog box as shown below:



In the above dialog box, we have specified a normal distribution with mean of 1.0 and standard deviation of 0.5, and generated 100 random samples from the distribution. The results are displayed in the spreadsheet on the right side.

Note 1: For "First parameter" and "Second Parameter" definitions, please see the section of " Probability Distribution Definitions and AuvTool Conventions "on opage 20.

Note 2: For information on how to save or export the sampling results, please see "Working with a Sheet" on page 96.

7.1 Generating Random Samples Based on Parametric Distributions

To generate random samples:

- Specify the distribution type, enter the first and second parameters, and specify the number of samples.
- Click Generate button, the sampling results will be displayed in the first column of the sheet.

Note 1: If you find that there are not sufficient significant figures in reporting results for small numbers, check the **Scientific Notation** labeled checkbox by clicking on it. The program will report the results in scientific format.

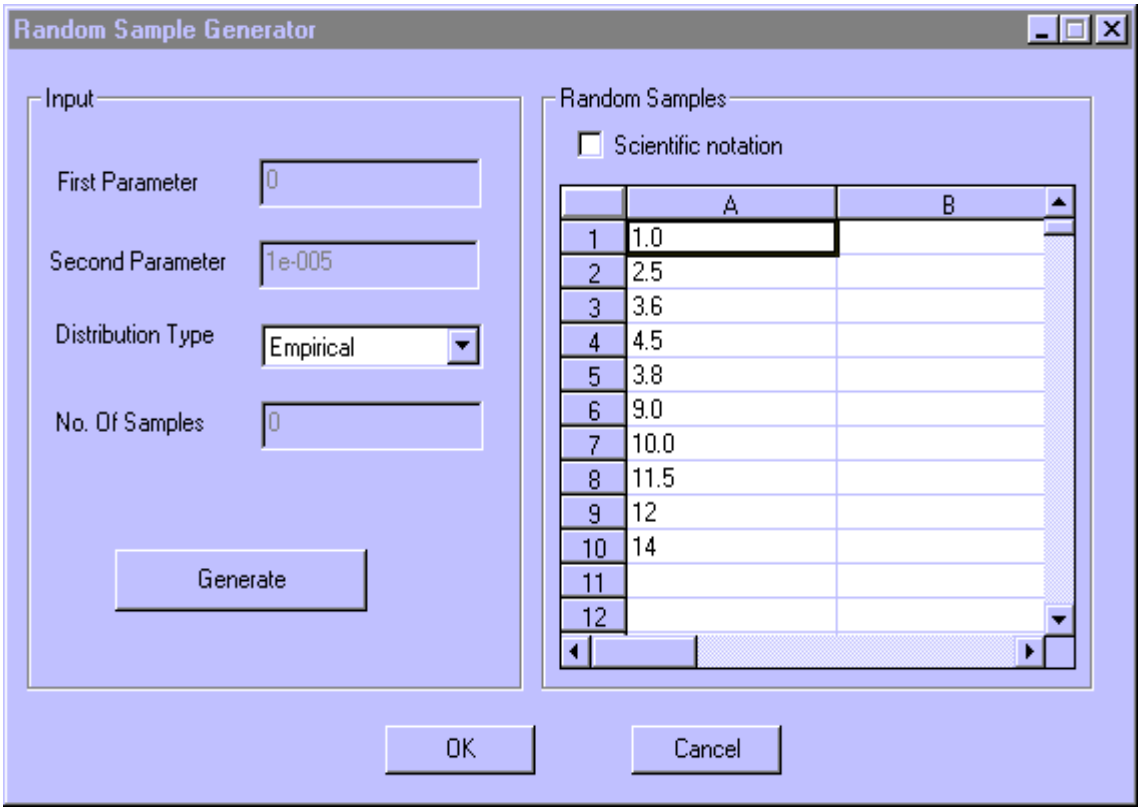
7.2 Generating Random Samples Based on Empirical Distribution

AuvTool has a feature to generate random samples based on an empirical distribution.

To generate random samples based on an empirical distribution:

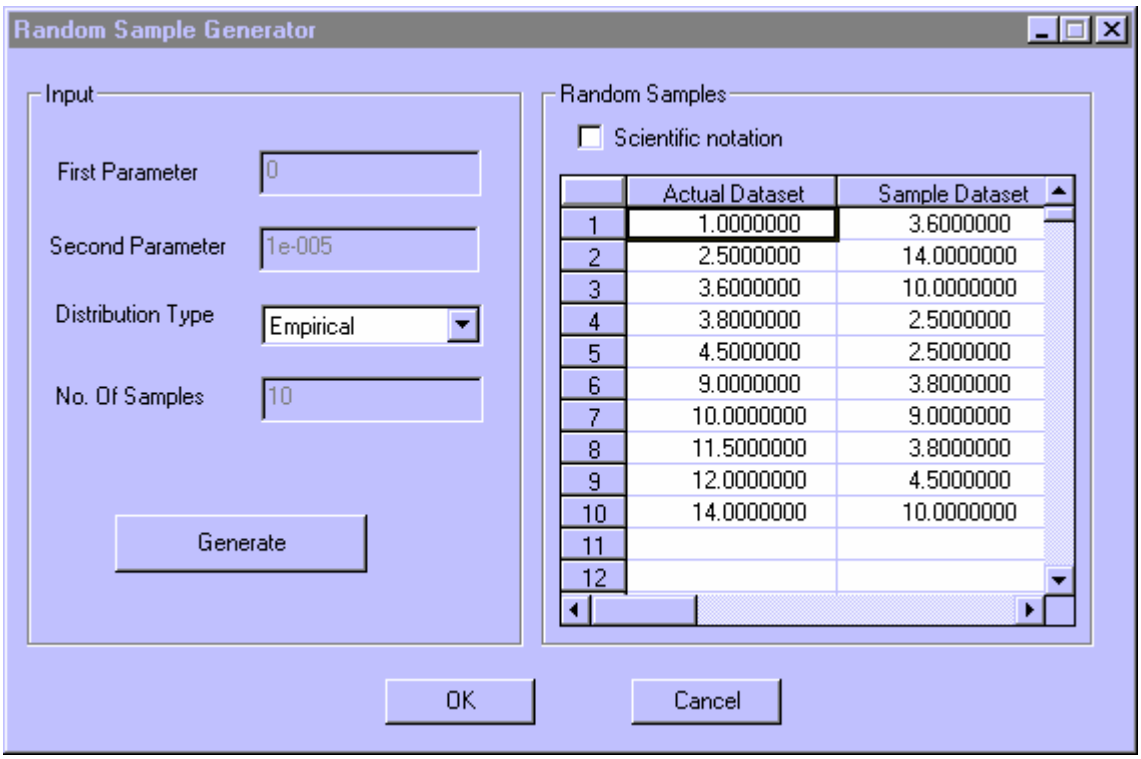
- Pull down the **Distribution Type** combo box in the Random Sample Generator dialog box, and select "Empirical Distribution." The program will

prompt you to enter your dataset into the first column of the data sheet. The ***Random Sample Generator*** dialog box will become:



- Enter your dataset into the first column of the sheet labeled "A" as shown in the above figure.
- Click the Generate button. The sampling results will be displayed in the second column of the sheet labeled "B" as shown on the next page.

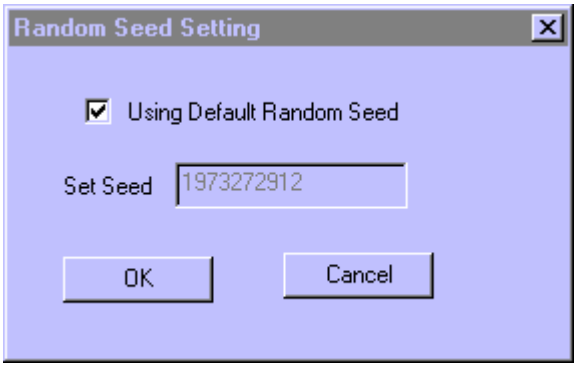
Note: If you find that there are not sufficient significant figures in reporting results for small numbers, check the **Scientific Notation** labeled checkbox by clicking on it. The program will report the results in scientific format.


Random Sample Generator
Input
First Parameter
0
Second Parameter
1e-005
Distribution Type
Empirical
No. Of Samples
10
Generate
Random Samples
Scientific notation
Actual Dataset
Sample Dataset
1 1.0000000 3.6000000
2 2.5000000 14.0000000
3 3.6000000 10.0000000
4 3.8000000 2.5000000
5 4.5000000 2.5000000
6 9.0000000 3.8000000
7 10.0000000 9.0000000
8 11.5000000 3.8000000
9 12.0000000 4.5000000
10 14.0000000 10.0000000
11
12
OK
Cancel

8.0 RANDOM SEED SETTING

In this section, we explain how to set a random seed for random sampling. By default, AuvTool has its own random seed. However, AuvTool provides a feature by which users can change the random seed for their special requirements.

You can enter the "Random Seed Setting" module by Pulling down the **Uncertainty** pull down menu and selecting **Random Seed Setting….** The program will display the following ***Random Seed Setting*** dialog box:



Random Seed Setting

8.1 Using the Default Random Seed

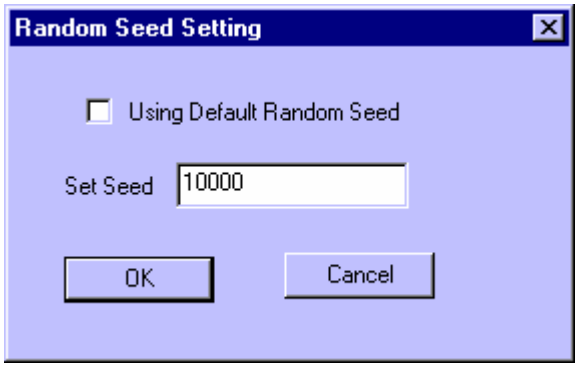
By default, the program will use its own random seed. If users would like to use the default random seed, they do not need to invoke the module at all. In some situations, if users have modified the default random seed in previous analysis, and they want to restore it; they need to reset the **Using Default Random Seed** labeled checkbox by simply clicking on the checkbox.

8.2 Changing the Random Seed

To change the random seed:

- Invoke the "Random Seed Setting" module as introduced above.
- Click on the **Using default Random Seed** labeled checkbox to remove the check mode.
- Enter one large number into the **Set Seed** labeled edit box.
- Click the OK button to accept the new random seed.

An example dialog box for changing the random seed is shown below:



Note: Whether or not you use the default random seed depends on your needs. Keeping the same seed will help you to duplicate your results. However, you can change the seed to generate a new series of random numbers such as to evaluate the stability of results for a given number of bootstrap simulations (See chapter 4 of the *Technical Documentation* for an example).

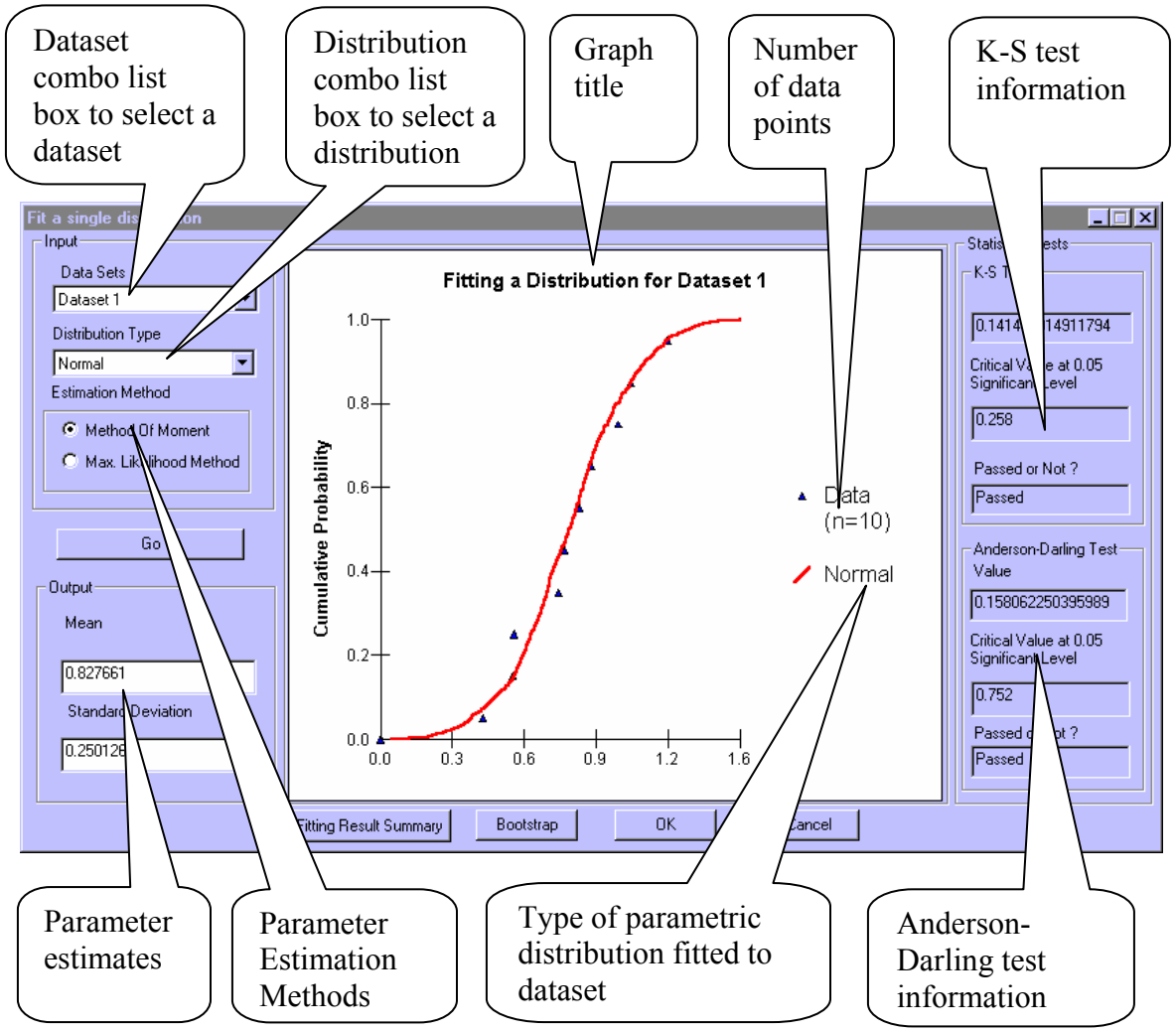
9.0 CHARACTERIZATION OF VARIABILITY: FITTING DISTRIBUTIONS DATASET BY DATASET

In this section, we will describe how to characterize the variability in a dataset by fitting a single distribution to a dataset. AuvTool can support your analysis of multiple datasets in this module. However, users must analyze datasets one by one, and can choose a best fit to a dataset based on their own judgment. AuvTool provides a feature to automatically help users to choose fits to their datasets; for more details on this feature, please see the "Characterization of Variability and Uncertainty: Batch Analysis" module on page 44.

You enter the "Characterization of Variability: Fitting Distributions Dataset by Dataset" module by pulling down the **Uncertainty** pull down menu and selecting **Single Distribution…**. The program will display the ***Fit a Single Distribution*** dialog box shown on the next page.

This module allows you to select a dataset to analyze, and to select parametric distributions to fit a dataset or to use an empirical distribution to describe a dataset. This module provides two different parameter estimation methods, Method of Matching Moment (MoMM) and Maximum Likelihood Estimation (MLE), for you to choose. This module allows you to visualize your selection of parametric distributions in comparison to the actual data and presents the K-S test and Anderson Darling test results to help you choose a good fit. The decisions made via the module provide a basis for uncertainty analysis.

Note 1: Initially, AuvTool assigns a default normal distribution to all datasets listed in the dataset list combo box, and sets MoMM as the default parameter



estimation method. When you invoke the module, as shown in the following figure, the program will by default analyze the first dataset and show its fitting results.

Note 2: For some distribution types, the MLE or MoMM estimation methods and the Anderson-Darling test are not available. Table 9-1 summarizes the availability of MoMM and MLE for probability distributions used in the AuvTool. Table 9-2 summarizes the Kolmogorov-Smirnov (K-S) and Anderson-Darling (A-D) test method availability for probability distributions used in AuvTool.

Table 9-1. Parameter Estimation Method Availability for Probability Distributions

Distribution Types	MoMM	(MLE)	Comments
Normal	√	√	Analytic solution for MLE
Lognormal	√	√	Analytic solution for MLE
Beta	√	√	Optimal Solution for MLE
Gamma	√	√	Optimal Solution for MLE
Weibull	▲	√	Optimal Solution for MLE
Uniform	√	N/A	
Symmetric Triangle	√	√	Optimal Solution for MLE

Note: √**:** The method is available for the given distribution.
▲: The plotting method is used instead of MOMM for Weibull distribution
N/A: The method is not available in this case

Table 9-2. Goodness-of-fit Test Method Availability for Probability Distributions

Distribution Types	Kolmogorov-Siminov Test	Anderson-Darling Test
Normal	√	√
Lognormal	√	√
Beta	√	
Gamma	√	√
Weibull	√	√
Uniform	√	
Triangle	√	

Note: √**:** The test is available for the given distribution.

Note 3: For some datasets, some distributions cannot be used to fit them. For example, lognormal, gamma and Weibull distributions cannot be used to describe datasets in which there are some negative values, and a beta distribution cannot represent a dataset in which some values are outside of the range between 0 and 1. If such situations occur, AuvTool will provide a message box to suggest that users choose other distributions. However, in some cases, the normal distribution might be chosen by a user or the automatic batch fit process to represent a dataset that must be non-negative. Because the program does not know which datasets must be

non-negative, it is the user's responsibility to make sure that the normal distribution is not used inappropriately.

Note 4: The data and parametric distributions are shown in terms of cumulative probability (on the Y-axis) versus values of the dataset (or a variable) (on the X-axis). Cumulative probability is the probability that a randomly selected sample within the variable will have a value less than or equal to the associated value of the variable on the X-axis.

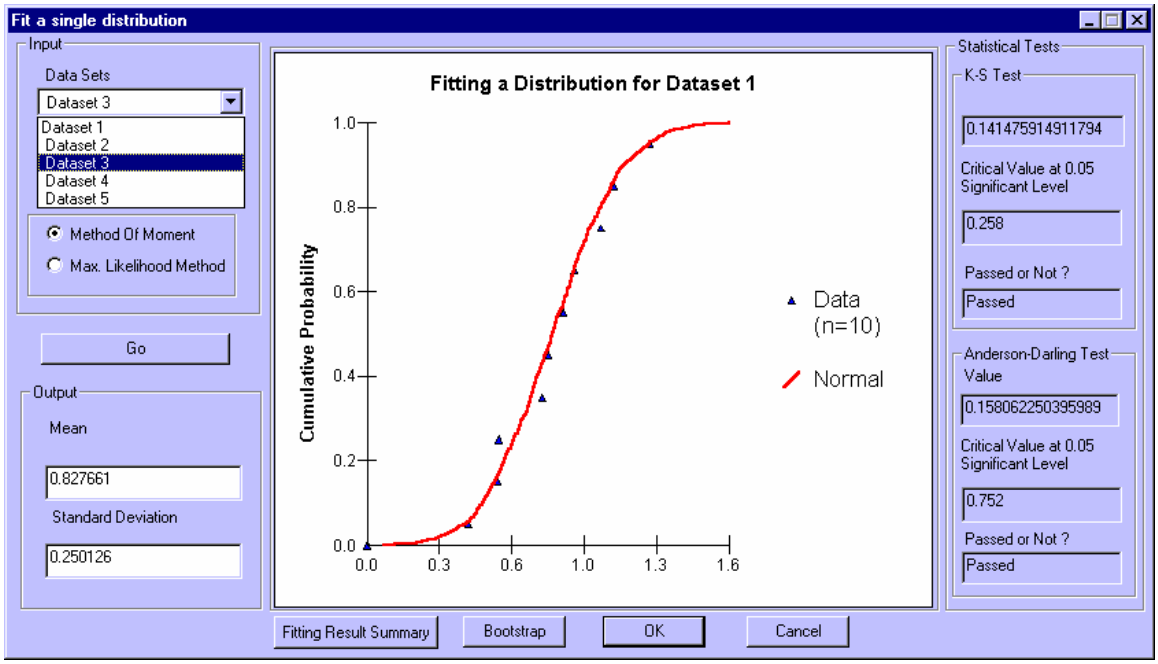
Note 5: On graphs that depict the origin of the X-axis, a spurious symbol appears at a cumulative probability of zero and an x-value of zero. This is not an actual data point; it is an artifact of the graphics routine used at this time.

Note 6: Each graph depicts both the available data set, shown as triangular data symbols, and the parametric distribution, shown as a smooth line. The legend of the graph indicates the number of data points available and the type of parametric distribution currently selected. The graphical display allows you to visualize both the data and the parametric distribution. Some disagreement will typically be evident when comparing the distribution to the data. The program gives you a capability to select from several alternative parametric distributions in most cases. You can choose the one that has the best fit in your opinion.

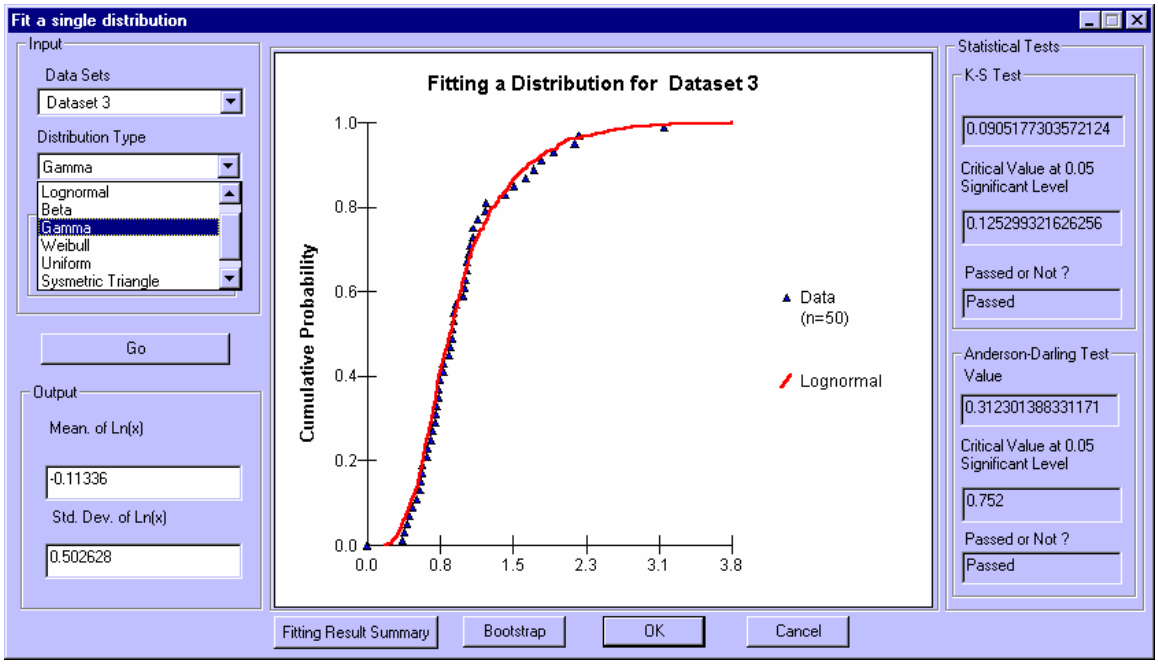
Note 7: If you want to edit a graph, save a graph as a file, or print a graph out, please see the section "Working with a Graph" on page 100.

9.1 Selecting a Dataset

If you have multiple datasets to analyze, you should select a dataset as a current dataset and then analyze it as shown below.



Fit a Single Distribution



Fit a Single Distribution

To select a dataset:

- Pull down the **Data Sets** labeled combo list box menu on the left hand position of the ***Fit a Single Distribution*** window;

- Click the dataset name you want to choose; and
- The graph will be updated automatically and the estimation results will also be updated.

9.2 Changing a Distribution Model for a Chosen Dataset

If you do not think that the current parametric probability distribution for the dataset you are analyzing is a good one, you can change it.

To make a change of parametric distribution:

- Pull down the **Distribution Type** combo list box menu on the left side of the ***Fit a Single Distribution*** window;
- Click the distribution type you want to choose; and
- The graph will be updated automatically and the estimation results will also be updated.

9.3 Changing Parameter Estimation Method

AuvTool provides options for users to choose one of two parameter estimation methods. The AuvTool sets MoMM as the default estimation method. However, users can freely choose either MoMM or MLE. For more information on the two parameter estimation methods, please see "Parameter Estimation of Parametric Probability Distributions" in the *Technical Documentation*.

To make a change of parameter estimation method:

- Click on the radio box of the method you want to choose.
- Click on the Go button on the left side of the ***Fit a Single Distribution*** window.

- The graph will be updated automatically and the estimation results will also be updated.

Note: For the uniform distribution, MLE is not available. In this situation, the MLE radio box is disabled. For the empirical distribution, neither MLE nor MoMM are applicable, so both of the radio boxes are disabled in this case.

9.4 Variability Analysis Results Summary for All Datasets

After you have reviewed or modified the selection of parametric probability distributions and parameter estimation method, you can obtain a summary of the distributions, parameters of distributions associated with each dataset, parameter estimation method used and statistical test results. To do this:

- Click the Fitting Result Summary button on the ***Fit a Single Distribution*** window.
- The program will display a popup ***Fitting Result*** Summary dialog box. More information can be found on "Variability Analysis Result Reporting" on page 79.

9.5 Entering Uncertainty Analysis Module

The decisions or choices of distribution types and parameter estimation methods you made in the "Characterization of Variability: Fitting Distributions Dataset by Dataset" module will provide a basis for uncertainty analysis using bootstrap simulation.

To enter the uncertainty analysis module:

- Click the Bootstrap button on the ***Fit a Single Distribution*** window.

- The program will display a popup ***Bootstrap Simulation*** dialog box with three tab-pages. More information on uncertainty analysis can be found on "Uncertainty Analysis: Bootstrap Simulation" on page 63.

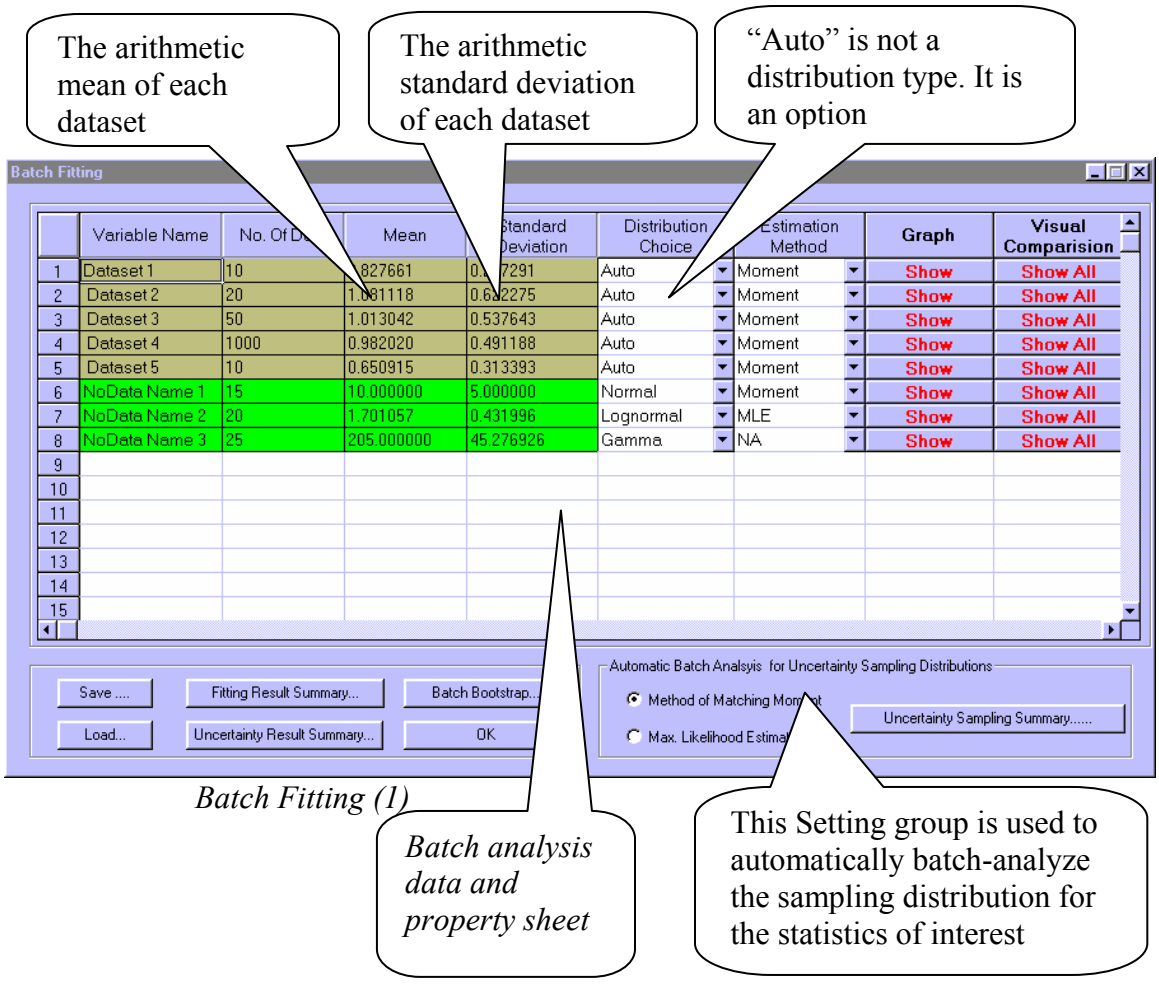
9.6 Exiting the Module

You have two ways to exit the module:

- The OK button or Cancel button on the ***Fit a Single Distribution*** window.
- Click the *Close* icon of the right corner of the ***Fit a Single Distribution*** window.

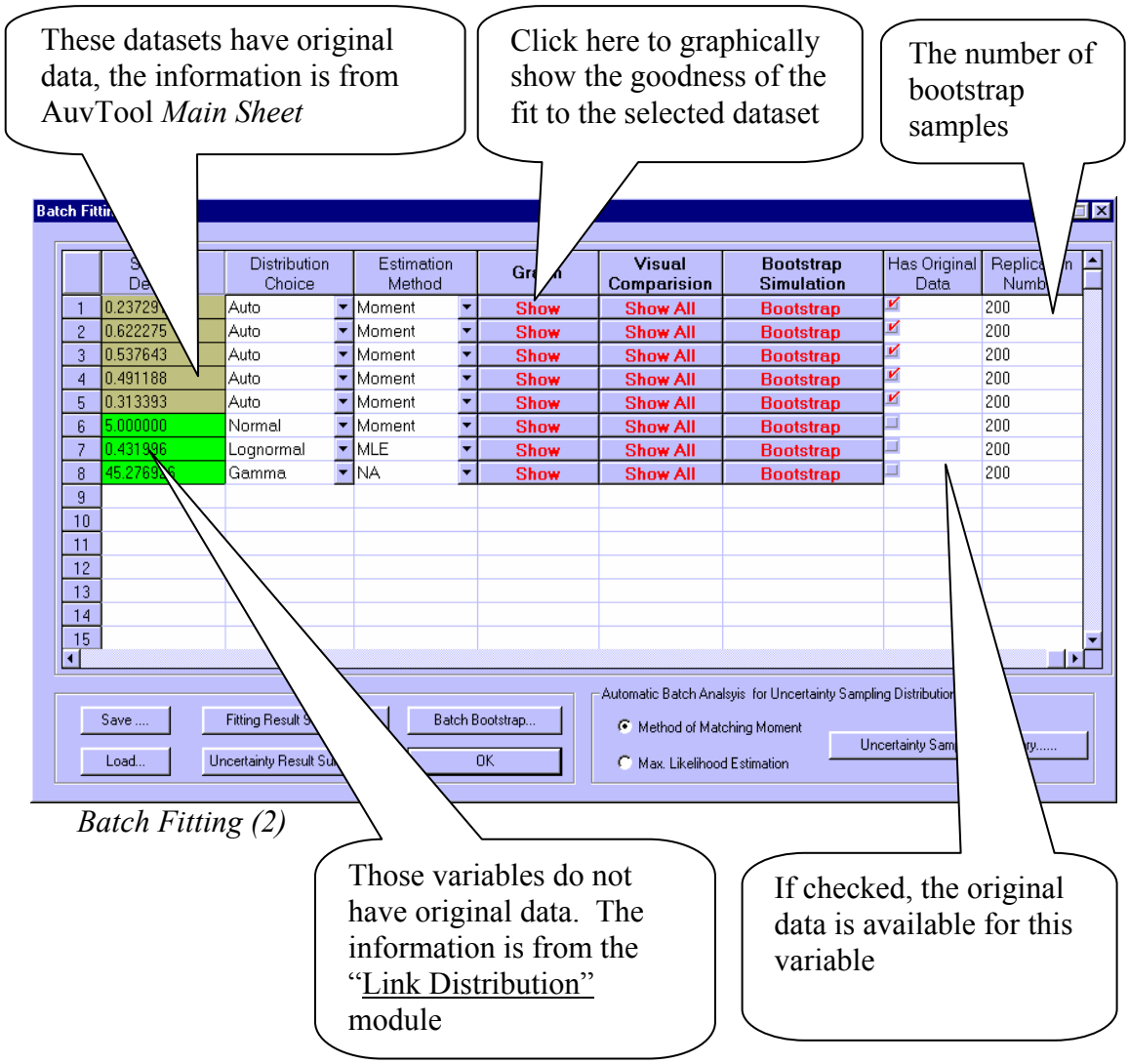
10.0 CHARACTERIZATION OF VARIABILITY AND UNCERTAINTY: BATCH ANALYSIS

This section describes the "Characterization of Variability: Batch Analysis" module in AuvTool used to quantify variability for multiple datasets. This module helps users automatically analyze multiple datasets. However, it also allows users to select a parameter estimation method and a fit to a dataset based on their own judgment. Therefore, it provides a flexible way for users to do variability analysis.



Batch Fitting (1)

You can enter the module by pulling down the **Batch Mode** pull down menu in the AuvTool Mainframe window and selecting **Batch Analysis….** The program will display the above ***Batch Fitting*** dialog box.



Batch Fitting (2)

The "Batch Analysis" module is more powerful than the "Fitting Distribution Dataset by Dataset" module previously introduced. It includes all features implemented in the "Fitting Distribution Dataset by Dataset" module, but also it provides the following capabilities of automatic batch analysis; and visual comparison of different distribution types fitted to a dataset; and uncertainty analysis for known distributions without the original datasets. Users can finish their analyses of variability and uncertainty for multiple datasets without having to make any choices. The program will automatically help users to choose best fits and to do uncertainty analysis. For the criteria of selecting

a best fit to a dataset, please refer to "Criteria for Automatically Seeking a Best Distribution Model in the Batch Mode Analysis" in the *Technical Documentation.*

The "Batch Analysis" module can support uncertainty analysis without original datasets if users can provide necessary distribution information. Users cannot directly introduce the information into the *batch analysis data and property sheet,* which must be done via the "Link Distribution" module. For more details on how to introduce the known distribution information into the "Batch Analysis" module, please see the module of "Load Distributions Information" on page 57.

WARNING: The user of AuvTool is cautioned that the availability of a batch mode technique for choosing a distribution based upon the K-S test is not a substitute for the use of judgment. The K-S test is based upon a specific criterion which may or may not be important to a particular analyst or decision maker in the context of a specific problem. The K-S test does not screen for results that may be physically implausible, such as a probability of sampling negative values for a quantity that must be non-negative. The appropriateness of selection of a distribution depends on the data quality objective of each analysis, which may differ from one situation to another. Therefore, uncritical application of the batch mode feature of AuvTool for seeking a best fit distribution is likely to lead to inappropriate selection of a probability distribution model in some cases. **It is the user's responsibility to evaluate the automatically selected parametric probability distribution for appropriateness with respect to the user's own criteria and needs**.

Note 1: All notes in the "Fitting Distribution Dataset by Dataset" module on page 41 also apply to the "Batch Analysis" module except the *Note* 1.

Note 2: In the batch analysis sheet, each row represents a dataset. All choices and actions made on the selected row will be effective only for the dataset on the row.

Note 3: In the column of Distribution Choice, "Auto" is not a distribution type, but an option. The program sets the "Auto" as the default option; "Auto" means that users let the program automatically choose a good fit for the selected dataset. For those cases that do not have original data, there is no "Auto" option available, and users cannot modify the distribution type. However, for those cases which do have original data, users can modify the option, and subjectively select the distribution type they want to fit.

Note 4: In the column of Estimation Method, for those cases which do not have original data, users cannot modify the parameter estimation method. If users do not have any information on the estimation method for some of those cases, the rows on the *batch analysis data and property sheet* will display as "NA". However, in uncertainty analysis, the program will by default assign MoMM to these cases. For those cases which have original data, users can freely select the parameter estimation method.

Note 5: The "Visual comparison" feature is not available for those cases which do not have original data.

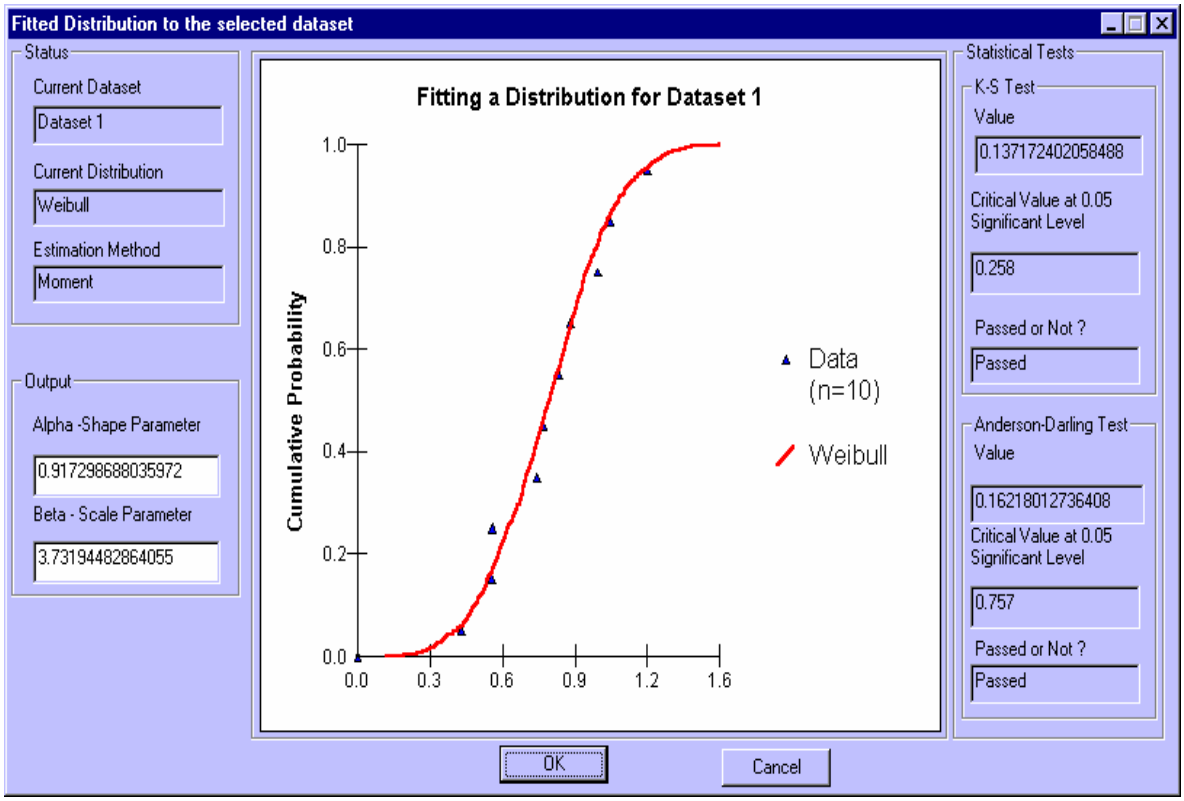
10.1 Showing a Graph of the Fitted Distribution for a Chosen Dataset

In the "Batch Analysis" module, AuvTool has a feature to let the user visualize the fitted distribution in comparison to a dataset.

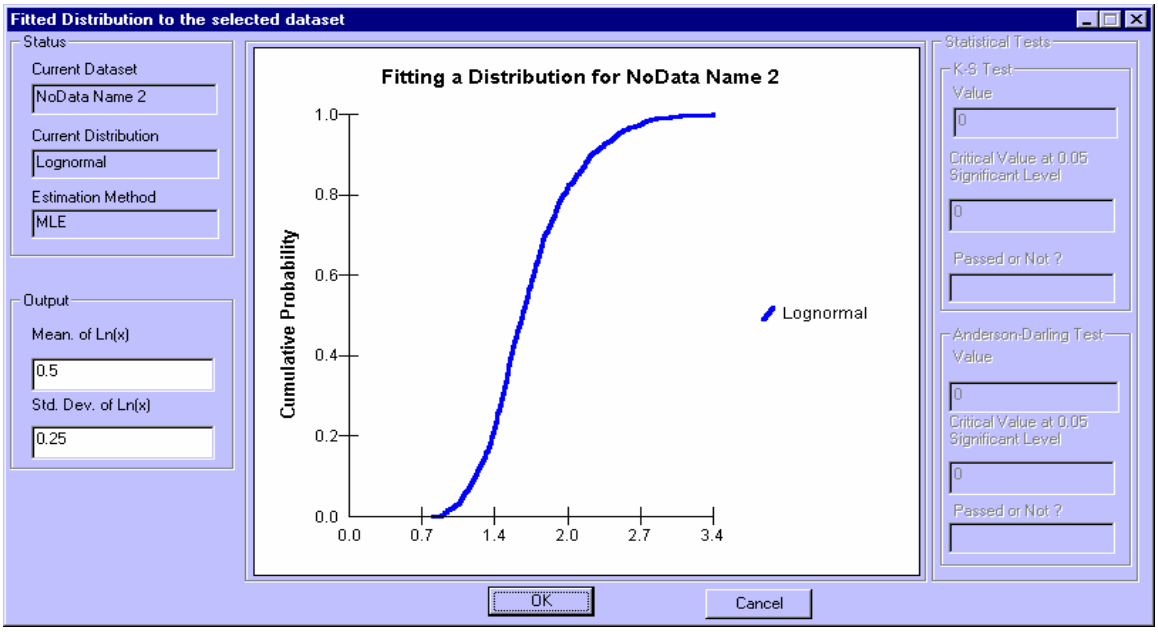
To show a graph of the fitted distribution for a chosen dataset:

- Click the Graph button on the row of the dataset you want to choose.
- The program will display the fitting result and graph in the ***Fitted Distribution to the Selected Dataset*** dialog box.

If the dataset you select has original data, the dialog box will look like the figure on the next page.



If the dataset you select does not have original data, the dialog box will look like:



Note 1: In the first case shown on the previous page, the user chose Dataset 1, and the "Auto" option for the distribution choice, and MoMM as the parameter estimation method. Users cannot modify any information inside the dialog box except for editing the graph.

Note 2: Since there is no original data available in the second case shown on the previous page, the program will only show the distribution that was specified by the user and cannot show any data.

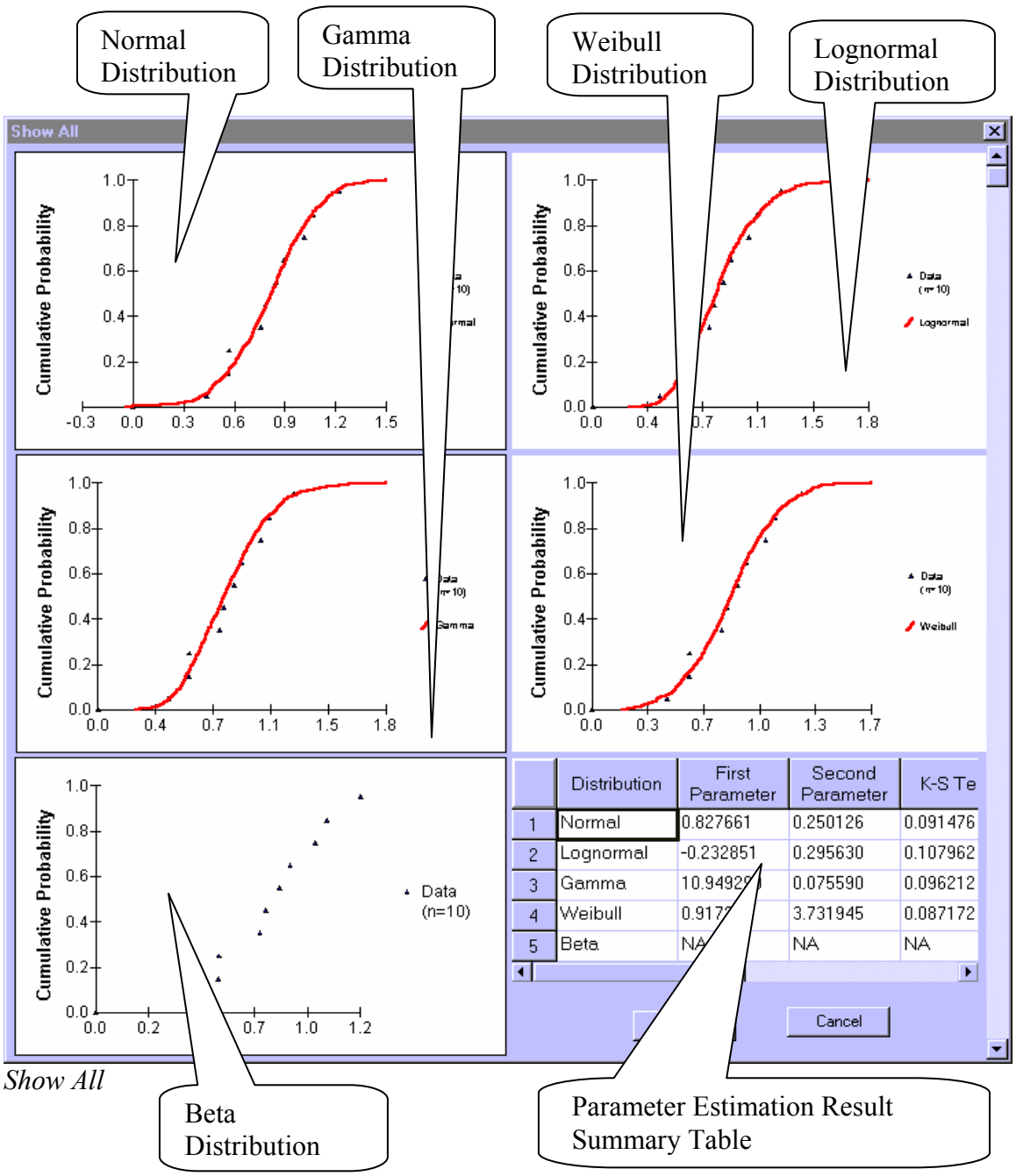
If you want to edit, save, print the graph, please see "Working with a Graph" on page 100.

10.2 Visual Comparison of Fitted Distributions with a Chosen Dataset

AuvTool implements a feature which allows users to visually compare different fitted distributions to a chosen dataset. To invoke this feature:

- Click the Show All button on the row of the dataset you want to choose

- The program will display the graphs of different fits on the following ***Show All*** dialog box as illustrated on the next page:



Show All

Note 1: The ***Show All*** dialog box is not available for the cases which do not have original data.

Note 2: No graphs will be displayed when the distribution types cannot be used to describe a dataset. For example, in the figure of the previous page, the graph of the beta distribution is not available because not all values in the dataset fall between 0 and 1.

10.3 Entering Uncertainty Analysis Module

In the "Batch Analysis" module, there are two ways to enter the "Uncertainty Analysis: Bootstrap Simulation*"* module. One is that you can click on the Bootstrap button inside the *batch analysis data and property sheet;* another is that you can click the on Batch Bootstrap… button on the left-bottom corner of the ***Batching Fitting*** dialog box. The difference is that bootstrap simulation will only be done on the dataset located at the button row for the former, while the later will contain all datasets inside the *batch analysis data and property sheet*.

In either case, the program will bring a popup ***Bootstrap Simulation*** dialog box with three tab-pages to the screen. More information on uncertainty analysis can be found on "Uncertainty Analysis: Bootstrap Simulation" on page 63.

10.4 Variability Analysis Result Summary for All Datasets

After you have reviewed or modified the selection of parametric probability distributions and parameter estimation method, you can obtain a summary of the type of distribution selected, parameters of the parametric probability distributions associated with each dataset, the parameter estimation method used in the case of parametric distributions, and goodness-of-fit statistical test results in the case of parametric distributions. To do this:

- Click the Fitting Result Summary button on the left-bottom corner of the ***Batch Fitting*** window.
- The program will display a popup ***Fitting Result*** Summary dialog box. More information can be found on "Variability Analysis Result Reporting" on page 79.

10.5 Uncertainty Analysis Result Summary for All Datasets

After you have reviewed or modified the selection of parametric probability distributions and parameter estimation methods for all datasets, you can obtain a summary of the uncertainty in the mean and standard deviation for all datasets. To do this:

- Click the Uncertainty Result Summary… button on the left-bottom corner of *Batch Fitting* window.
- The program will display a popup ***Uncertainty Analysis*** Summary dialog box. More information can be found on "Uncertainty Analysis Result Reporting" on page 84.

10.6 Saving the Current Batch Analysis Data and Property Sheet

You can save for future analysis your choices made on the datasets by saving the current *Batch Analysis Data and Property Sheet* to an AuvTool file format.

To save the current data sheet:

- Click the Save… button on the left-bottom corner of ***Batch Fitting*** window.
- The program will display a ***Save as*** file dialog box.

- Enter a filename with an extension of ".ss3". Click the Save button in the ***Save as*** dialog box.

10.7 Loading the Existing Batch Analysis Data and Property Sheet

You can load the files describing the batch analysis information back to the *Batch Analysis Data and Property Sheet.* However, before you can do any further analysis, you also need to load the file containing the corresponding original datasets into the AuvTool *main sheet.* If there exists some cases without the original data in the *Batch Analysis Data and Property Sheet,* you also need to link the distribution information file to the "Link Distribution" module.

To load the Existing Batch Analysis Data and Property Sheet:

- Click the Load… button on the left-bottom corner of ***Batch Fitting*** window
- The program will display an ***Open*** file dialog box.
- Choose the file name you want to load, click the Open button in the ***Open*** dialog box.

10.8 Automatic Batch Analysis of the Sampling Distribution Data for Statistics of Interest

AuvTool not only provides a summary of uncertainty in the mean and standard deviation, but also includes a feature which allows users to do further analysis regarding the sampling distribution data from bootstrap simulation for selected statistics of interest. This feature enables users to fit a parametric probability distribution to the simulated data for the sampling distribution of the mean, standard deviation, and distribution parameters. In the "Batch Analysis" module, the program provides an automatic batch calculation to

accomplish these tasks. By simply invoking the feature, the program will do batch bootstrap simulation for all datasets inside the *Batch Analysis Data and Property Sheet,* automatically find the best parametric probability distribution model to fit to the statistics of interest for all datasets, and report the analysis results.

To do this:

- Select the parameter estimation method for the sampling distribution by clicking one of two radio boxes on the right-bottom corner of the ***Batching Fitting*** window. The program will set MoMM as the default parameter estimation method.
- Enter the replication number, which refers to of the number of bootstrap sample that will be simulated for bootstrap simulations. The program sets 200 as the default number. However, larger values will give more numerically stable results at the expense of longer run-time.
- Click the Uncertainty Sampling Summary…. button on the right-bottom corner of the ***Batching Fitting*** window. The program will display the ***Summary on the Fitted Distributions to the Statistics of Interest*** dialog box. More information on the summary can be found in the "Uncertainty Analysis Result Reporting" on page 84.

WARNING: The user of AuvTool is cautioned that the availability of a batch mode technique for choosing a distribution based upon the K-S test is not a substitute for the use of judgment. The K-S test is based upon a specific criterion which may or may not be important to a particular analyst or decision maker in the

context of a specific problem. The K-S test does not screen for results that may be physically implausible, such as a probability of sampling negative values for a quantity that must be non-negative. The appropriateness of selection of a distribution depends on the data quality objective of each analysis, which may differ from one situation to another. Therefore, uncritical application of the batch mode feature of AuvTool for seeking a best fit distribution is likely to lead to inappropriate selection of a probability distribution model in some cases. **It is the user's responsibility to evaluate the automatically selected parametric probability distribution for appropriateness with respect to the user's own criteria and needs**.

Note 1: In the automatic batch analysis, the program assumes that the replication number (number of bootstrap samples) of the bootstrap simulation for all datasets is the same, and that the number of sample for estimating the variability for each alternative frequency distribution is the same as the replication number.

Note 2: Recommended that values for the replication number of the bootstrap simulation are from 200 to 2000.

Note 3: The program provides a module which allows users to select parametric distributions to fit to the sampling data for the statistics of interests. For more information, please see the "Uncertainty Analysis: Bootstrap Simulation" module and "Analyzing the Sampling Data for the Statistics of Interest" module.

10.9 Exiting the Batch Analysis Module

You have two ways to exit the module:

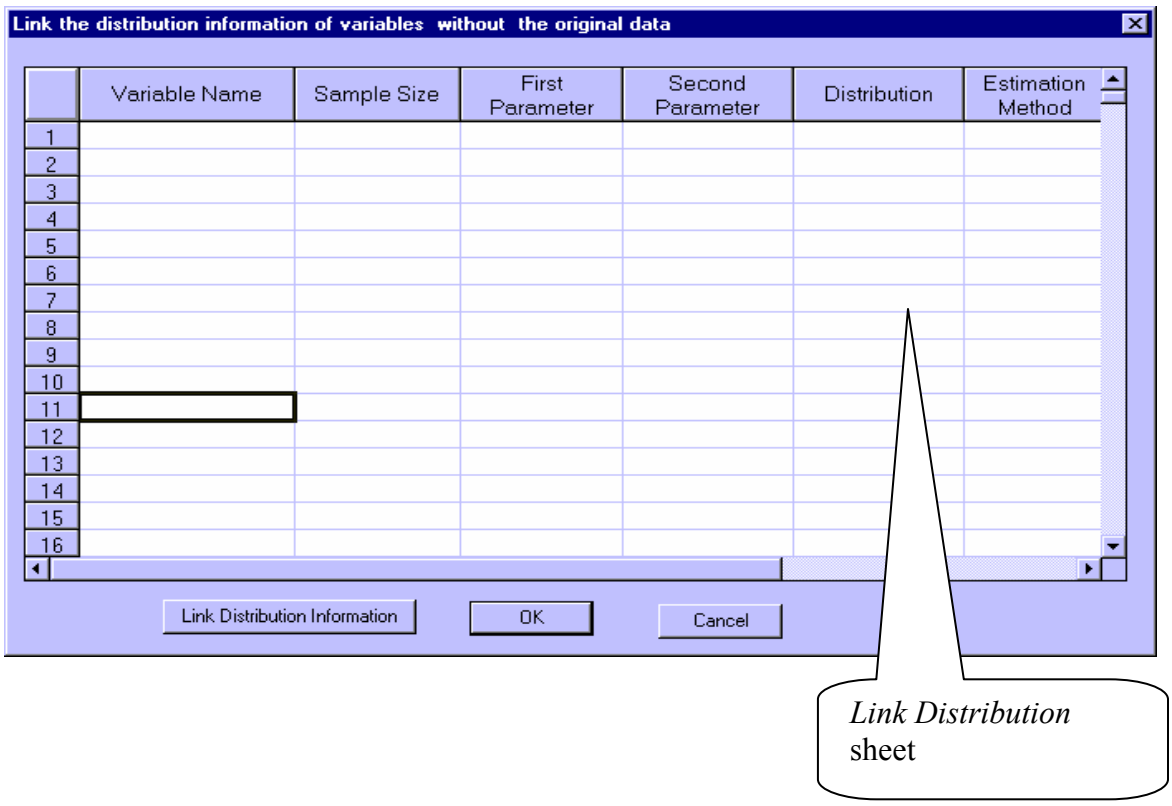
- The OK button on the ***Batch Fitting*** window.
- Click the *Close* icon of the right-top corner of the ***Batch Fitting*** window.

11.0 ENTER OR LOAD DISTRIBUTIONS INFORMATION WITHOUT ORIGINAL DATA

For some quantities, a user may know the type of parametric distribution that others selected as a best fit to a dataset, but may not have access to the data set itself. As long as sufficient information about the fitted distribution is available, it is still possible to estimate uncertainty in selected statistics and regarding the CDF of the parametric distribution. The minimum data requirements include the type of distribution (i.e., normal, lognormal, beta, gamma, Weibull, uniform and symmetric triangle distribution), the numerical value of the two distribution parameters, and the number of data points that were used in the dataset from which the parameters were estimated. The "Link Distributions" module introduced in this section provides a way for a user to enter information about a distribution even though the original data are not available. In ture this enables users to do uncertainty analysis even though the original data are not available. In this section, you will learn how to provide the distribution information to the AuvTool for uncertainty analysis use.

You can enter the "Link Distributions" module by pulling down the **Batch Mode** pull down menu and selecting **Link Distributions….** The program will display the ***Link the Distribution Information of Variables without the Original Data*** dialog box shown on the next page.

You can provide the distribution information via four ways. You can enter information by keyboard, load data from an existing AuvTool disk file, import data from other file formats or use the Window **copy** and **paste** command to provide the necessary information.



Note 1. Each row represents the distribution information for one variable

11.1 Brief Explanation of Input Specification of Columns

There are six columns in the *Link Distribution* sheet. The input specification for each column is introduced as follows:

Variable Name: In this column, you can specify any name for the variables you are analyzing. There is no limit for your variable name length.

Sample Size: In this column, you should provide the number of data points for the original data for the known distribution. In some cases, you might not have such information. However, you may also enter any value for sample size you wish to explore how the range of uncertainty in selected

statistics is influenced by sample size. A suggested value when the sample size is unknown but believed to be small is 5.

First Parameter: please see the "AuvTool Conventions" on page 20 for more details.

Second Parameter: please see the "AuvTool Conventions" on page 20 for more details.

Distribution: In this column, you should provide the distribution type. You can enter either the distribution name or the distribution code representing the distribution. The following tables specifies the input for the column:

Table 11-1. Input Specifications for the ***Distribution*** Column

Distribution Name	Distribution Code
Normal	0
Lognormal	1
Beta	2
Gamma	3
Weibull	4
Uniforma	5
Triangle	6

Note: Distribution name is not case sensitive.

Estimation Method: In this column, enter the codes to represents the estimation method. 0 stands for MoMM, 1 for MLE, and if you have no information for the estimation method, enter –1, AuvTool will by default assign MoMM to the latter case in uncertainty analysis.

11.2 Input Distribution Information from the Keyboard

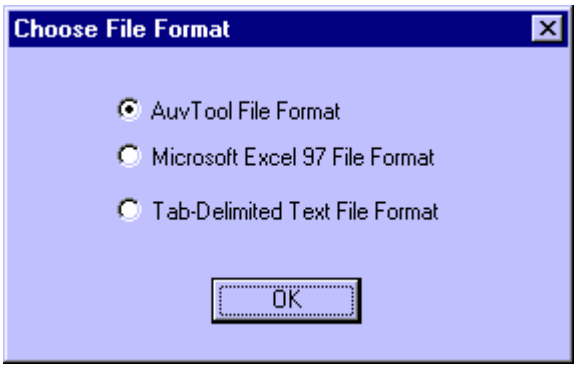
By following the input specifications introduced above, you can input the distribution information by moving the cursor (highlighted cell) to a cell and then typing

the corresponding contents required for the cell. Using the right arrow to move the cursor to the next cell at the row you are working on to get other information. After finishing all inputs for one variable, press the <Enter> key to move to the next row to input the distribution information for other variables. Repeating this process until you finish inputs for all variables. If you want to change the data in a cell, just move the cursor to the cell, type another value and press <Enter>.

11.3 Loading Existing Distribution Information from a File

You can load the existing distribution information files into the *Link Distribution* sheet. In this module, AuvTool support three file formats: AuvTool file format; Microsoft Excel ™ 97 file format; and tab-delimited text file. To load a file:

- Click the Link Distribution Information… button of the left-bottom corner of the *Link the distribution information of variables without the original data* dialog box.
- The program will display the following ***Choose File Format*** dialog box:



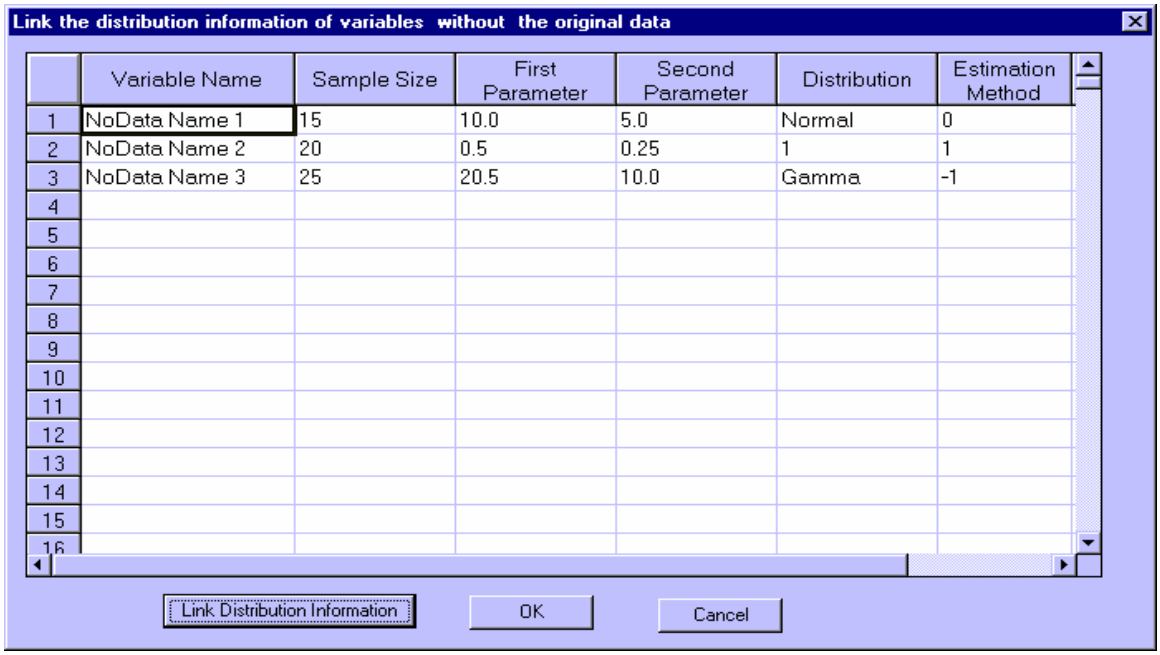
- Select the format of the file you want to open; then Click the OK button.
- The program will display a standard *Open File Dialog* as shown in the "Data Entry, Importing and Exporting " module on the page 22.

- Enter the file name and click the *Open* button. The program will load the existing distribution files into the *Link Distribution* sheet. An example *Link Distribution* sheet is shown on the next page after loading the existing distribution file:

Note 1: In this example, we load an AuvTool file. The file is an example used to analyze variables without original data in the "Batch Analysis" and other modules. The user can find this file in the working directory of AuvTool.

Note 2: After you load the distribution files for the variables without original data, you can do uncertainty analysis for these variables in the "Batch Analysis" module. However, you need to exit the "Link Distribution" module before you do further analysis.

Note 3: For any operations on the sheet, please see "Working with a Sheet" on page 96.



11.4 Exiting the Module

You have two ways to exit the Fitting Distribution module:

- If you want to load the distribution information for uncertainty analysis, click the OK button in the window. The program will automatically link the information to other modules. This information will be used in the "Batch Analysis" and "Uncertainty Analysis" modules.
- If you do not want to load the distribution information for further analysis, just click the Cancel button. The program will exit the window without passing any information to other modules.

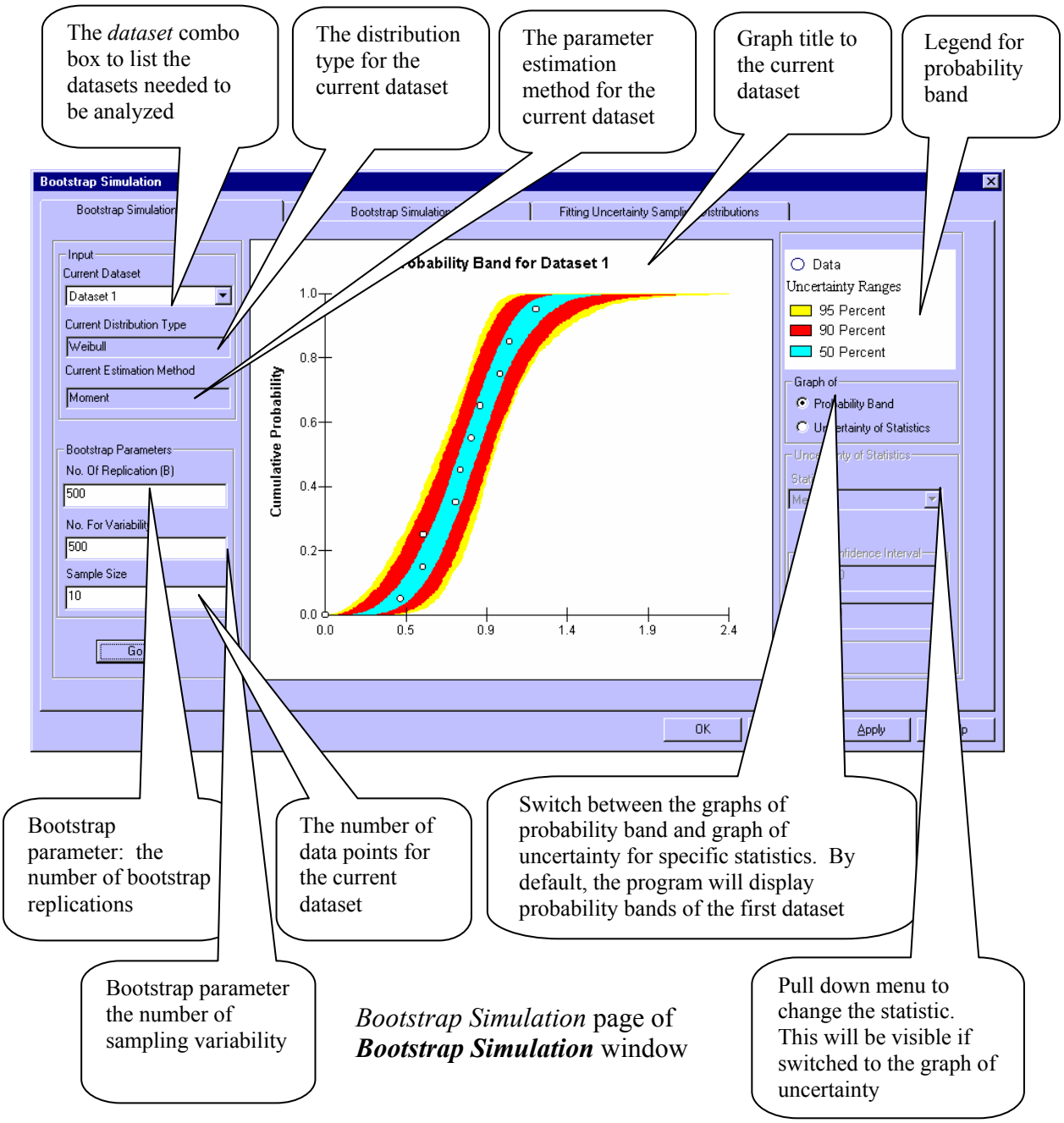
12.0 UNCERTAINTY ANALYSIS: BOOTSTRAP SIMULATION

In this section, you will learn how to do uncertainty analysis using bootstrap simulation.

You can enter the "Uncertainty Analysis*:* Bootstrap Simulation*"* module by clicking on the Bootstrap button on the ***Fit a Single Distribution*** window, or by clicking on the Batch Bootstrap… button on the left-bottom corner of the ***Batch Fitting*** window, or by clicking the Bootstrap button inside the *batch analysis data and property sheet* on ***Batch Fitting*** window. More details on how to enter the module can be found in the discussion for "Enter the Uncertainty Analysis Module" in the section of "Characterization of Variability: Fitting Distribution Dataset by Dataset" on page 36 and in the section of " Characterization of Variability and Uncertainty: Batch Analysis" on page 44.

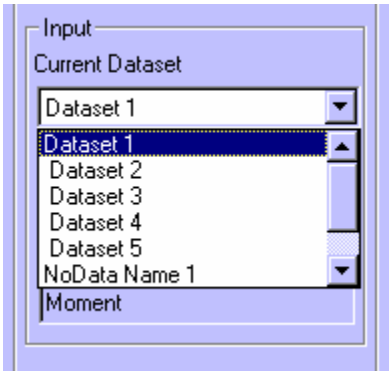
Regardless of how you enter the "Uncertainty Analysis: Bootstrap Simulation" module, the program will pop up a ***Bootstrap Simulation*** window as shown on the next page. There are three tab-pages shown at the top within the ***Bootstrap Simulation*** window, which are the "***Bootstrap Simulation Graph****"* page, the "***Bootstrap Simulation Data****"* page, and the "***Fitting Uncertainty Sampling****"* page.

The program will, by default, show the probability bands of the first dataset or variable of the dataset listed on the "***Bootstrap Simulation Graph****"* page. The probability bands depict a 50 percent, a 90 percent, and a 95 percent confidence interval of the CDF of the distribution fitted to the data. The user can display other variables by selecting the desired variable or dataset listed in the combo box on the left-top corner within the "***Bootstrap Simulation Graph"*** tab page of the ***Bootstrap Simulation*** window.



Bootstrap Simulation page of ***Bootstrap Simulation*** window

Note 1: The above figure is from the Batch Bootstrap button within the ***Batch Fitting*** window. There are five datasets which have original data and three datasets without original data. The following figure shows the example dataset name list in the dataset combo box:



Note 2: The program, by default, sets the number of bootstrap simulation replications as 200 and the number of samples to simulate variability for each alternative frequency distribution as 200. However, users can change these two numbers, and redo the bootstrap simulation accordingly. The allowable range for each of two numbers is from 200 to 2000. It is not necessary to always keep the two numbers the same.

Note 3: The probability bands are not available for the empirical distribution.

Note 4: If you want to do any editing for a graph, please see the section "Working with a Graph" on page 100.

12.1 Doing a Bootstrap Simulation

Bootstrap simulation is done separately for each dataset in the dataset list box. Before you can do a bootstrap simulation, you must select a dataset. To do this:

- Pull down the dataset combo list box as shown on the previous page, and click on the desired dataset name.
- The program will update the information in the **current distribution type** labeled edit box and the one in the **current the estimation method** labeled edit box for the selected dataset.

- Change the bootstrap simulation parameters as introduced above, if desired.
- Click the Go button on the left-bottom corner of the "***Bootstrap Simulation Graph***" page. The display will be updated to show the probability bands of the fitted distribution or uncertainty estimate of the statistics you chose for your selected dataset. It might take some time to get the results, which depends on the speed of your computer, the parameter estimation method used for the selected dataset, and the values you choose for the bootstrap simulation parameters. In rare cases, if you use MLE for beta, gamma and the Weibull distributions, and if the delay seems too long, it could be because of a failure of the nonlinear optimization method. If this situation occurs, please see the "Troubleshooting" section on page 118.

12.2 Brief Explanation of the Graphical Displays

The graphical results available in the "***Bootstrap Simulation Graph***" page are of two main types:

1. *Probability Band:* Shown here are 50 percent, 90 percent and 95 percent probability bands for the parametric distribution fitted to the dataset for the currently selected variable. The method by which the probability bands are calculated is described in the accompanying technical manual. These probability bands depict a plausible range which may enclose the "true" but unknown distribution. For example, the 95 percent probability band may be thought of as a 95 confidence interval. This interval has a 95 percent

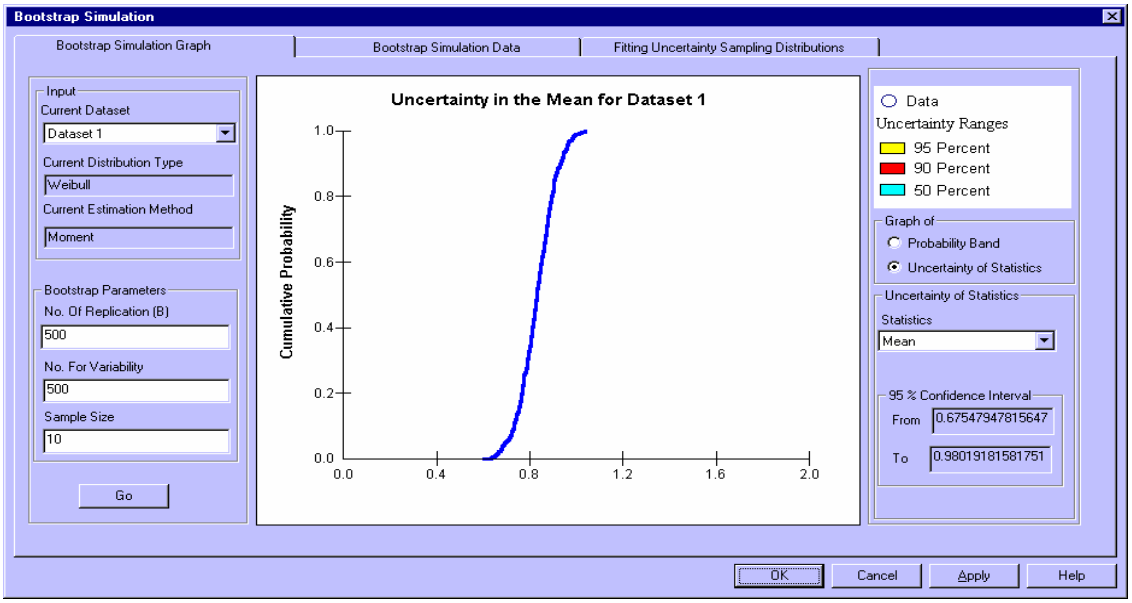
probability of enclosing the true but unknown distribution. The probability bands tend to be wider in range with very small datasets and/or in situations with large variation within the available sample of data. From the probability bands you can obtain a confidence interval for any percentile of the distribution.

2. *Uncertainty of Statistics:* If you click on the Uncertainty of Statistics radio button on the right hand side of the "***Bootstrap Simulation Graph****"* page, you will obtain a graphical display of a probability distribution for a selected statistic of the current variable. A statistic is a function of a random dataset. For example, a mean, standard deviation, or distribution parameter is calculated from the random sample of data. Any value calculated from a random data set is itself random. A probability distribution for a statistic is referred to as a " sampling distribution." Sampling distributions are the basis for constructing confidence intervals. The AuvTool program displays for you the sampling distribution of the statistic you select from the Uncertainty of Statistics pull down menu on the lower right of the *"**Bootstrap Simulation Graph**"* page. The 95 percent confidence interval for that statistic is also shown, and it is based on the range from the 2.5^{th} percentile to the 97.5^{th} percentile of the sampling distribution.

12.3 Switching Between Graphs of Uncertainty and Probability Bands

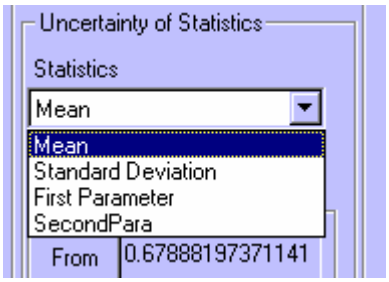
To switch between graphs of probability bands and of uncertainty in statistics, select the appropriate radio button on the right side of the *"**Bootstrap Simulation Graph**"* page the under the "Graph of" text.

1. If the AuvTool program is displaying the probability band of a variable, click the Uncertainty of Statistics radio button. The program will switch to show the graph of uncertainty for a selected statistic. By default, the graph will display the uncertainty in the mean as the following figure named the *Uncertainty* window.



Bootstrap Simulation: *Uncertainty* Graph

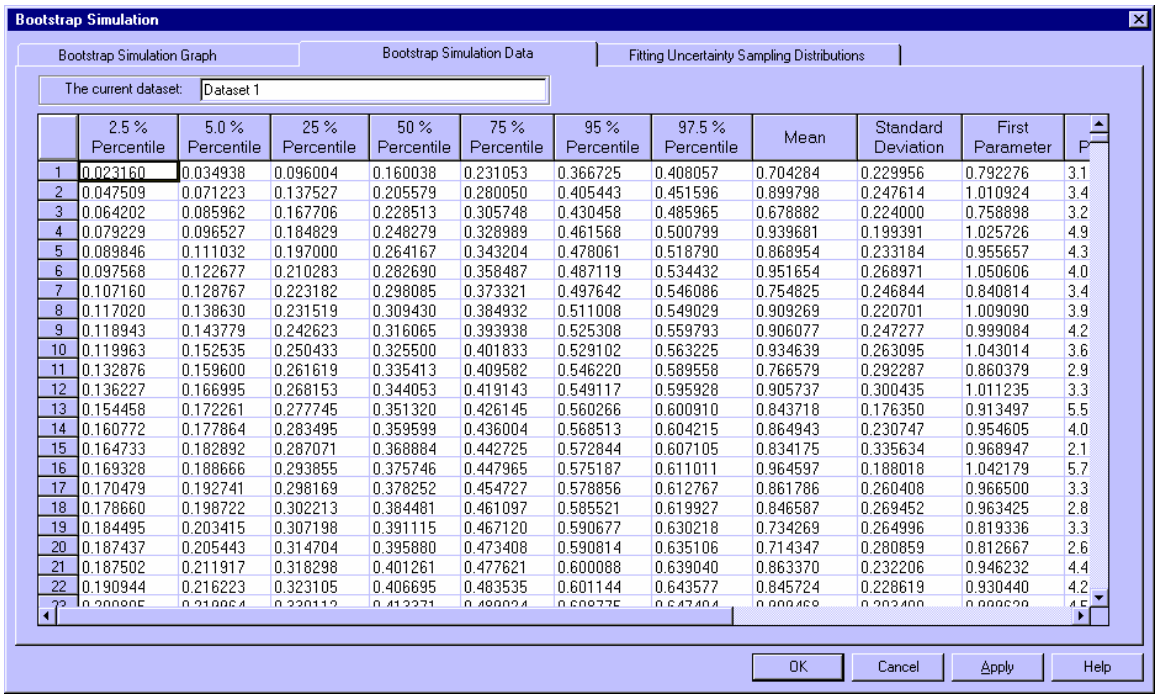
Note: You can change the type of statistics whose uncertainty is displayed by pulling down the combo list box labeled **Statistics** and by clicking on one of the statistics. The following figure displays the combo list box.



2. If the program is showing a graph of uncertainty for a statistic, click the Probability Band radio button to switch to a display of the probability bands for the fitted distribution for variability.

12.4 Displaying and Saving the Bootstrap Simulation Data

AuvTool provides the bootstrap simulation data. To display or save the data, click the "***Bootstrap Simulation Data***" tab page. The program will display the following window:



	2.5 % Percentile	5.0 % Percentile	25 % Percentile	50 % Percentile	75 % Percentile	95 % Percentile	97.5 % Percentile	Mean	Standard Deviation	First Parameter	P
1	0.023160	0.034938	0.096004	0.160038	0.231053	0.366725	0.408057	0.704284	0.229956	0.792276	3.1
2	0.047509	0.071223	0.137527	0.205579	0.280050	0.405443	0.451596	0.899798	0.247614	1.010924	3.4
3	0.064202	0.085962	0.167706	0.228513	0.305748	0.430458	0.485965	0.678882	0.224000	0.758898	3.2
4	0.079229	0.096527	0.184829	0.248279	0.328989	0.461568	0.500799	0.939681	0.199391	1.025726	4.9
5	0.089846	0.111032	0.197000	0.264167	0.343204	0.478061	0.518790	0.868954	0.233184	0.955657	4.3
6	0.097568	0.122677	0.210283	0.282690	0.358487	0.487119	0.534432	0.951654	0.268971	1.050606	4.0
7	0.107160	0.128767	0.223182	0.298085	0.373321	0.497642	0.546086	0.754825	0.246844	0.840814	3.4
8	0.117020	0.138630	0.231519	0.309430	0.384932	0.511008	0.549029	0.909269	0.220701	1.009090	3.9
9	0.118943	0.143779	0.242623	0.316065	0.393938	0.525308	0.559793	0.906077	0.247277	0.999084	4.2
10	0.119963	0.152535	0.250433	0.325500	0.401833	0.529102	0.563225	0.934639	0.263095	1.043014	3.6
11	0.132876	0.159600	0.261619	0.335413	0.409582	0.546220	0.589558	0.766579	0.292287	0.860379	2.9
12	0.136227	0.166995	0.268153	0.344053	0.419143	0.549117	0.595928	0.905737	0.300435	1.011235	3.3
13	0.154458	0.172261	0.277745	0.351320	0.426145	0.560266	0.600910	0.843718	0.176350	0.913497	5.5
14	0.160772	0.177864	0.283495	0.359599	0.436004	0.568513	0.604215	0.864943	0.230747	0.954605	4.0
15	0.164733	0.182892	0.287071	0.368884	0.442725	0.572844	0.607105	0.834175	0.335634	0.968947	2.1
16	0.169328	0.188666	0.293855	0.375746	0.447965	0.575187	0.611011	0.964597	0.188018	1.042179	5.7
17	0.170479	0.192741	0.298169	0.378252	0.454727	0.578856	0.612767	0.861786	0.260408	0.966500	3.3
18	0.178660	0.198722	0.302213	0.384481	0.461097	0.585521	0.619927	0.846587	0.269452	0.963425	2.8
19	0.184495	0.203415	0.307198	0.391115	0.467120	0.590677	0.630218	0.734269	0.264996	0.819336	3.3
20	0.187437	0.205443	0.314704	0.395880	0.473408	0.590814	0.635106	0.714347	0.280859	0.812667	2.6
21	0.187502	0.211917	0.318298	0.401261	0.477621	0.600088	0.639040	0.863370	0.232206	0.946232	4.4
22	0.190944	0.216223	0.323105	0.406695	0.483535	0.601144	0.643577	0.845724	0.228619	0.930440	4.2

These data include the 2.5%, 5.0%, 25%, 50%, 75%, 95%, 97.5% percentiles that represent probability bands, these probability bands can be used to construct confidence intervals of the CDF of the distribution fitted to the data. For example, the 95 percent confidence interval for the CDF is enclosed by the 2.5% and 97.5% percentile bands.

The sampling distribution data for the mean, standard deviation and the distribution parameters for the current dataset being analyzed are also given.

Note1: The sheet only displays the bootstrap simulation data for the dataset that the user is analyzing. If you want to display data for another dataset, go back to the "***Bootstrap Simulation Graph****"* page, select the desired dataset, do the bootstrap simulation, and then come back to the "***Bootstrap Simulation Data****"* page.

Note 2: For the "First Parameter " and "Second Parameter" definitions inside the above the datasheet, please see "Distribution Definitions and AuvTool Conventions" on page 18.

Note 3: To save the current data sheet or to do any operations on the datasheet, please see "Working with a Sheet" on page 96.

12.5 Entering the Module of Analyzing the Sampling Data of Statistics of Interest

After you have done a bootstrap simulation, you can obtain the sampling distribution data for the mean, standard deviation, and the parameters of the fitted distribution. You might want to fit parametric distributions to the sampling distribution data for the statistics of interest. AuvTool offers a feature to do this. To enter the module of "Analyzing the Sampling Data of Statistics of Interest", click on the "***Fitting Uncertainty Sampling Distribution****"* tab page within the ***Bootstrap Simulation*** window. For more information on the module, please see the section on "Analyzing the Sampling Data of the Statistics of Interest" on page 72.

Note: If you tried to enter the module without having finished a bootstrap simulation for some datasets or variables, the program will provide a warning message box to show you the datasets or variables for which bootstrap simulation has not been completed. You can go ahead to do the analysis of fitting distributions to the sampling data for those datasets for which bootstrap simulations have been done. However, you cannot do such an analysis for the datasets for which bootstrap simulations have not been done. You can go back to the "***Bootstrap Simulation Graph***" page to do the bootstrap simulation for such datasets.

12.6 Exiting the Module

You have two ways to exit the "Uncertainty Analysis: Bootstrap Simulation" module:

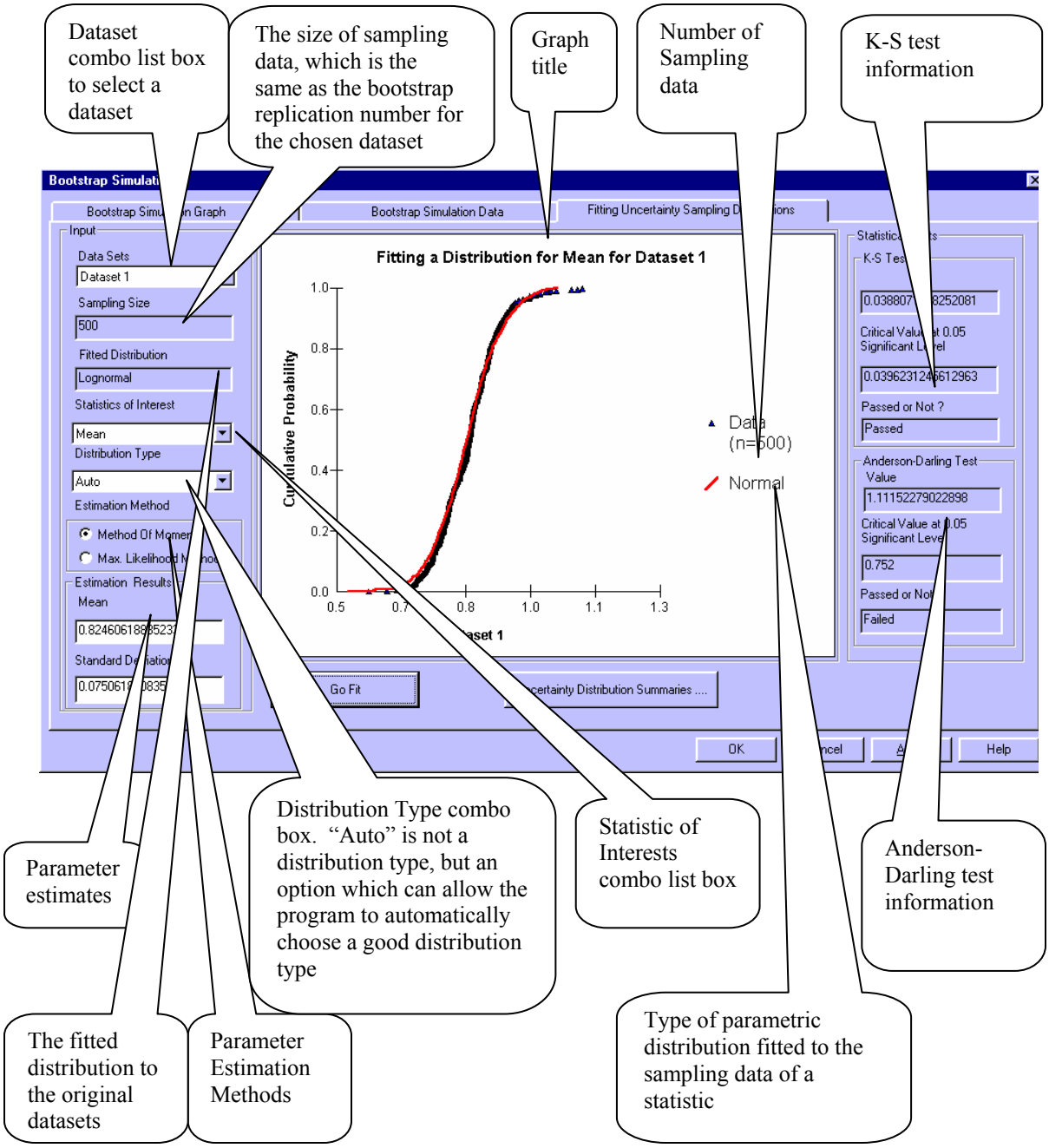
- Click the OK button on the ***Bootstrap Simulation*** window.
- Click the Cancel button on the ***Bootstrap Simulation*** window.

13.0 ANALYZING THE SAMPLING DATA OF THE STATISTICS OF INTEREST

In this section, we will describe how to fit a distribution to represent the sampling distribution data of the statistics of interest that were obtained from bootstrap simulations for the datasets or variables that you are analyzing. Basically, this module is very similar to the "Charterization of Variability: Fitting Distribution Dataset by Dataset " module on page 36. The main difference is that the former analyzes the sampling distribution data of statistics of interest from bootstrap simulation for a chosen dataset, while the later focuses on characterizing variability for an original dataset. Another difference is that this module also has a feature which can automatically help users to choose a best fit to the sampling distribution data of a statistic, while the later does not.

Before you can enter into the module of "Analyzing the Sampling Data of the Statistics of Interest", first you need to enter into the module of "Uncertainty Analysis: Bootstrap Simulation." Please refer to the "Uncertainty Analysis: Bootstrap Simulation" module on page 63 for more details. When the "Uncertainty Analysis: Bootstrap Simulation" module is active, there is a ***Bootstrap Simulation*** window with three tab-pages shown as on page 73. From there you can enter into the "Analyzing the Sampling Data of the Statistics of Interest" module by clicking on the "***Fitting Uncertainty Sampling Distribution*****"** labeled tab page. The program will go to the "***Fitting Uncertainty Sampling Distribution*****"** page, which is shown on the next page:

This module provides two different parameter estimation methods: MoMM and MLE. This module allows you to visualize your own selection of parametric distributions in comparison to actual data and presents the K-S test and Anderson Darling test results to help you choose a good fit.



WARNING: The user of AuvTool is cautioned that the availability of a batch mode technique for choosing a distribution based upon the K-S test is not a substitute for the use of judgment. The K-S test is based upon a specific criterion which may or may not be important to a particular analyst or decision maker in the

context of a specific problem. The K-S test does not screen for results that may be physically implausible, such as a probability of sampling negative values for a quantity that must be non-negative. The appropriateness of selection of a distribution depends on the data quality objective of each analysis, which may differ from one situation to another. Therefore, uncritical application of the batch mode feature of AuvTool for seeking a best fit distribution is likely to lead to inappropriate selection of a probability distribution model in some cases. **It is the user's responsibility to evaluate the automatically selected parametric probability distribution for appropriateness with respect to the user's own criteria and needs**.

Note 1: Whenever you enter into the module, if there are some datasets for which bootstrap simulations have not been completed, the program will provide a warning message box to tell you which datasets have not been analyzed using bootstrap simulation. You will not have sampling distribution data to analyze in this module for such datasets. If you want to analyze the sampling distribution data of statistics of interest for such datasets, you will need to go back to the "***Bootstrap Simulation Graph"*** page to do bootstrap simulation. See the module of "Uncertainty Analysis: Bootstrap Simulation" on page 63 for more details. Then come back to the module to complete analysis on those datasets.

Note 2: Initially, AuvTool assigns "Auto" to the **Distribution Type** labeled combo list box for all statistics of interest and for all datasets. This means that the program will automatically help users to choose a best distribution for the statistics of

interests if users accept the default settings. In addition, the program uses MoMM as the default parameter estimation method.

Note 3: For some distribution types, MLE or MoMM and A-D tests are not available. Please refer to Table 9-1 and Table 9-2 on pages 40 and 41, respectively

Note 4: For some datasets, particular distributions cannot be used to fit to them. For example, lognormal, gamma and Weibull distributions cannot be used to describe datasets in which there are some negative values, and the beta distribution cannot represent a dataset in which some values are outside of the range from 0 to 1. If such situations occur, the AuvTool will provide a message box to suggest that users choose other distributions.

Note 5: The data and parametric distribution are shown in terms of cumulative probability (on the Y-axis) versus values of the sampling dataset (on the X-axis). Cumulative probability is the probability that a randomly selected value from the distribution will be less than or equal to the fractile of the distribution associated with the specific value of cumulative probability.

Note 6: On graphs that depict the origin of the X-axis, a spurious symbol appears at a cumulative probability of zero and an x-value of zero. This is not an actual data point; it is an artifact of the graphics routine used at this time.

Note 7: Each graph depicts both the available sampling data set, shown as triangular data symbols, and the parametric distribution, shown as a smooth line. The legend of the graph indicates the sample size and the type of parametric distribution currently selected. The graphical display allows you to visualize both the data and the parametric distribution. Some disagreement will typically be evident

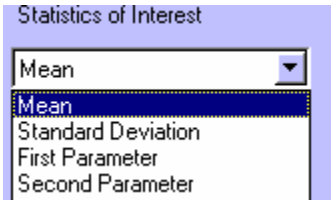
when comparing the distribution to the data. The program gives you a capability to select from several alternative parametric distributions in most cases. You can choose the one that has the best fit in your opinion.

Note 8: If you want to edit a graph, save a graph as a file, or print a graph out, please see the section "Working with a Graph" on page 100.

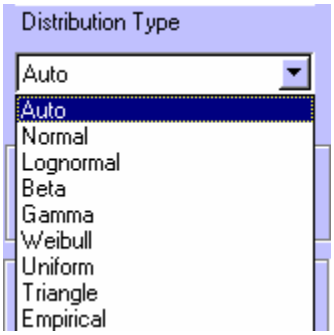
13.1 Fitting a Distribution for a Statistic

To fit a parametric distribution to a sampling distribution data set for a selected statistic:

- Select a dataset by pulling down the **Data Sets** labeled combo list box menu on the top-left corner position of the "***Fitting Uncertainty Sampling Distribution***" page, and click on the dataset name you want to choose. The program will update the information of the **Sampling Size** labeled box and the **Fitted Distribution** labeled edit boxes for the corresponding dataset you chose.
- Select a statistic of interest by pulling down the **Statistics of Interest** labeled combo list box menu on the left side of the module as shown below:



- Select a distribution to fit to the sampling distribution data for the chosen statistic by pulling down the **Distribution Type** labeled combo list box menu on the left side of the module as shown below:



- Select an estimation method in the **Estimation Method** radio box group by clicking on one of them.
- Click the Go Fit button to fit the chosen distribution to the sampling distribution data for the statistic of your chosen dataset using the estimation method you chose. The graph will be updated automatically and the estimation results and goodness-of-fit test results will also be updated.

13.2 Summarizing the Fitted Distributions for the Statistics of Interest

AuvTool provide a module to summarize the distributions fitted to the sampling distribution data for the statistics of interest. You can enter into the module by clicking on the Uncertainty Distribution Summary…. button on the right-bottom corner of the "***Fitting Uncertainty Sampling Distribution***" page. The program will display the ***Summary on the Fitted Distributions to the Statistics of Interest*** dialog box. More information on the summary can be found in "Uncertainty Analysis Result Reporting" on page 84.

13.3 Exiting the Module

You have three ways to exit the "Analyzing the Sampling Data of the Statistics of Interest" module.

If you just want to switch to the other pages within the ***Bootstrap Simulation*** window, click one of them on the page tabs.

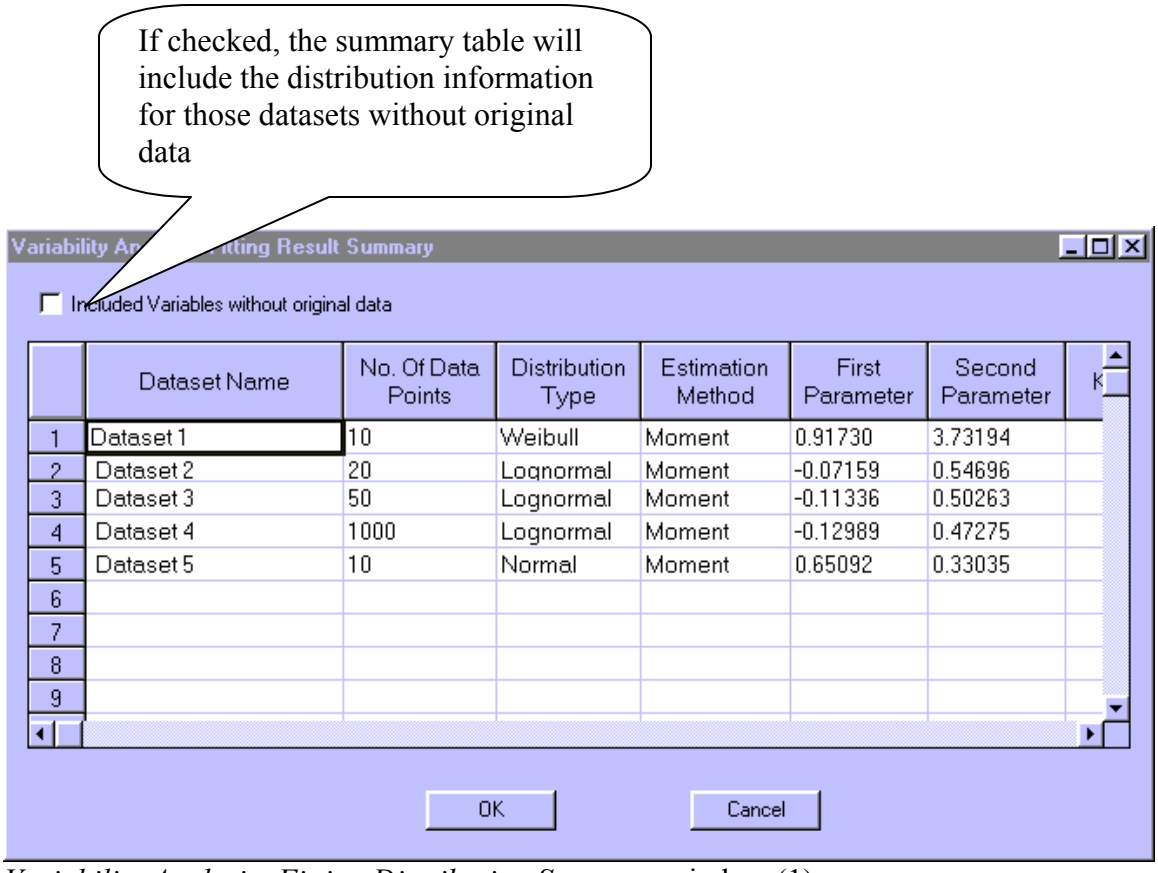
If you have completed all analyses and also want to exit the " uncertainty analysis" module:

- Click the OK button on the ***Bootstrap Simulation*** window.
- Click the Cancel button on the ***Bootstrap Simulation*** window.

14.0 VARIABILITY ANALYSIS RESULT REPORTING

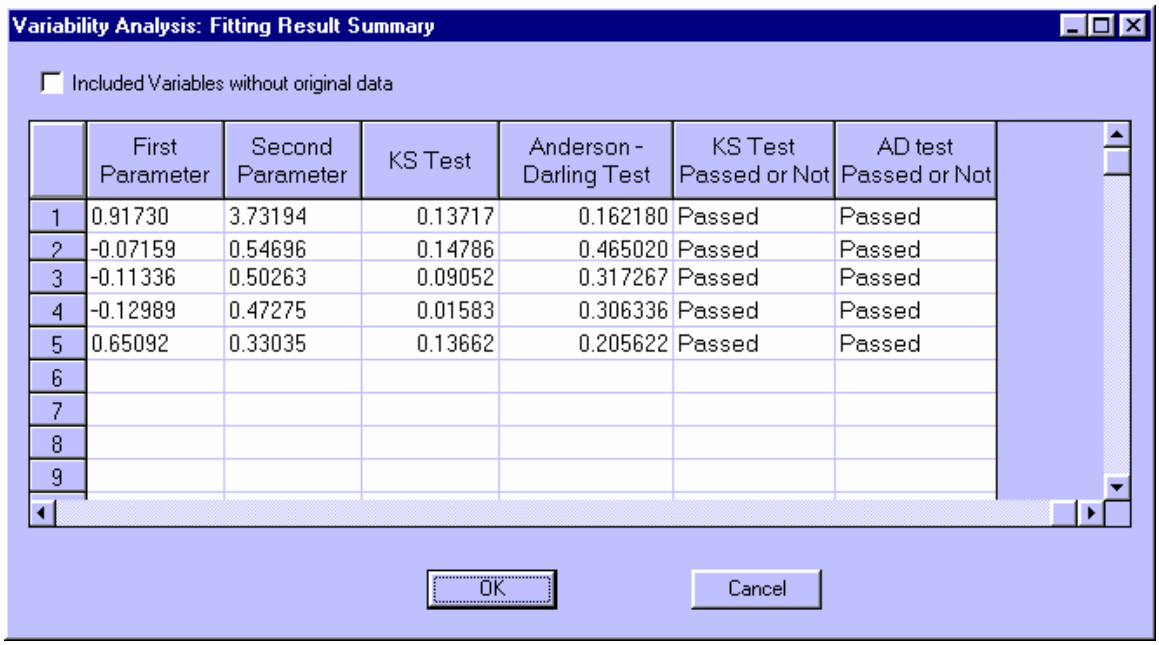
The purpose of the "Variability Analysis Result Reporting" module is to summarize the selected results of variability analysis for the user.

You can enter the module either by clicking on the Fitting Distribution Summary… button at the bottom of the ***Fit a Single Distribution*** window or by clicking on the Fitting Distribution Summary… button at the left-bottom of the ***Batch Fitting*** window. When you click on either of them, the program will display the following ***Variability Analysis: Fitting Distribution Summary*** window:



Variability Analysis: Fitting Distribution Summary window (1)

The program, by default, will only display the fitting result information for those variables with original data. However, if desired, users can also display the distribution information for variables without original data by clicking on the check box within the



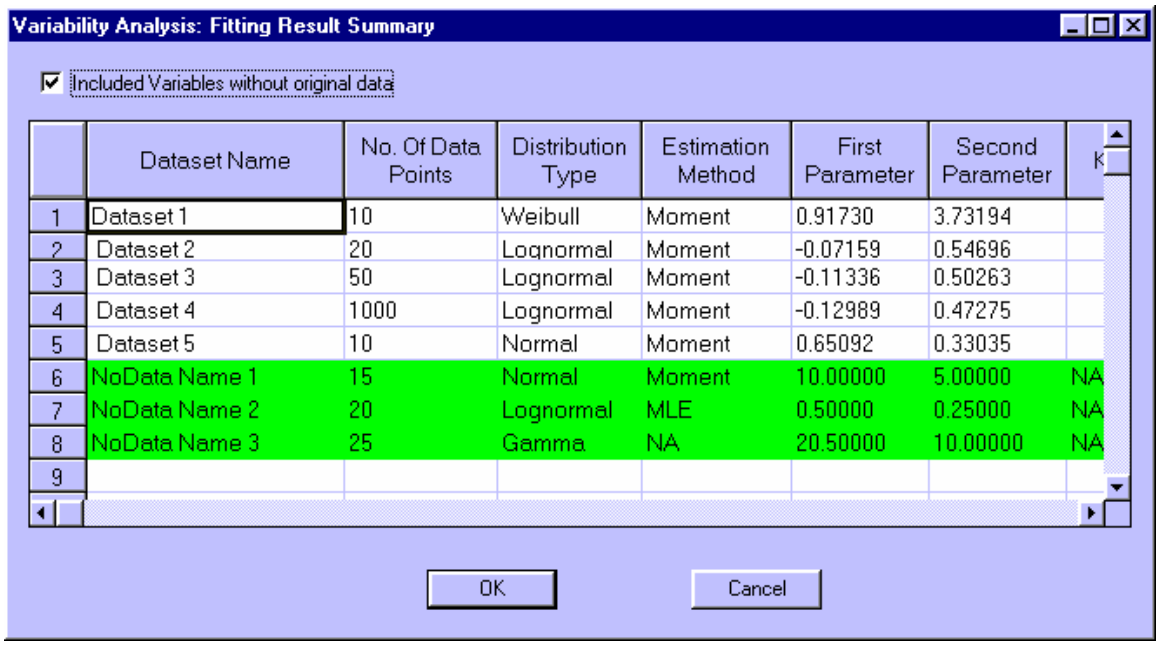
	First Parameter	Second Parameter	KS Test	Anderson - Darling Test	KS Test Passed or Not	AD test Passed or Not
1	0.91730	3.73194	0.13717	0.162180	Passed	Passed
2	-0.07159	0.54696	0.14786	0.465020	Passed	Passed
3	-0.11336	0.50263	0.09052	0.317267	Passed	Passed
4	-0.12989	0.47275	0.01583	0.306336	Passed	Passed
5	0.65092	0.33035	0.13662	0.205622	Passed	Passed
6						
7						
8						
9						

Variability Analysis: Fitting Distribution Summary window (2)

above window. The figure on the next page displays the distribution information for all variables included in the example used in the User's Guide. The example was introduced on page 23.

Note 1: The figure shown on the next page comes from the ***Batch Fitting*** window. Therefore, in the example, the check box labeled "Included variables without data" is enabled. If the ***Variability Analysis: Fitting Distribution Summary*** window is opened from the ***Fit a Single Distribution*** window, then the check box will be disabled.

Note 2: For those variables without original data, there are no K-S test or A-D test results available. The cells associated with the tests will be marked as " NA".



Variability Analysis: Fitting Distribution Summary window (3)

14.1 Brief Explanation of Columns in the Fitting Result Summary Table

The following briefly introduces what each column in the summary table means:

Dataset Name: In this column, the variable names are listed for the variables you analyzed.

No. of Data Points: The number of data points are given for each dataset.

Distribution Type: The distribution type used to represent the corresponding dataset is indicated.

Estimation Method: The estimation method used to estimate the parameters for the fitted distribution is given. Typically, there are two available estimation methods, MLE and MoMM, which are marked as " MLE" and "Moment" in the corresponding cells. For those variables without original data, there is no information available in some cases regarding which

method was used to estimate the parameters, and the corresponding cell will be marked as "NA".

First Parameter and **Second Parameter:** The fitted distributions parameters are given for each variable. Please see the "Distribution Definitions and AuvTool Conventions" on page 18 for more details.

KS test: The K-S test statistic value is reported for the fitted distribution.

Anderson-Darling test: The Anderson-Darling test statistic value is reported for the fitted distribution. Since this test is not available for the beta, uniform and symmetric triangle distribution, the values are reported as "0.0" or "-1.0" in such cases.

KS Test Passed or not: The corresponding cell will be marked as "Passed" or "Failed." If no information is available, "NA" will be reported.

AD Test Passed or not: The corresponding cell will be marked as "Passed" or "Failed." If no information is available, "NA" will be reported.

14.2 Exporting Fitting Result Summary Table

You can export the fitting results to other file formats or to your applications. You can copy, save and export the fitting results summary sheet. Please see the section on "Working with Sheet" on page 96 for more details.

14.3 Exiting the Module

You have two ways to exit the ***Variability Analysis: Fitting Distribution Summary*** window:

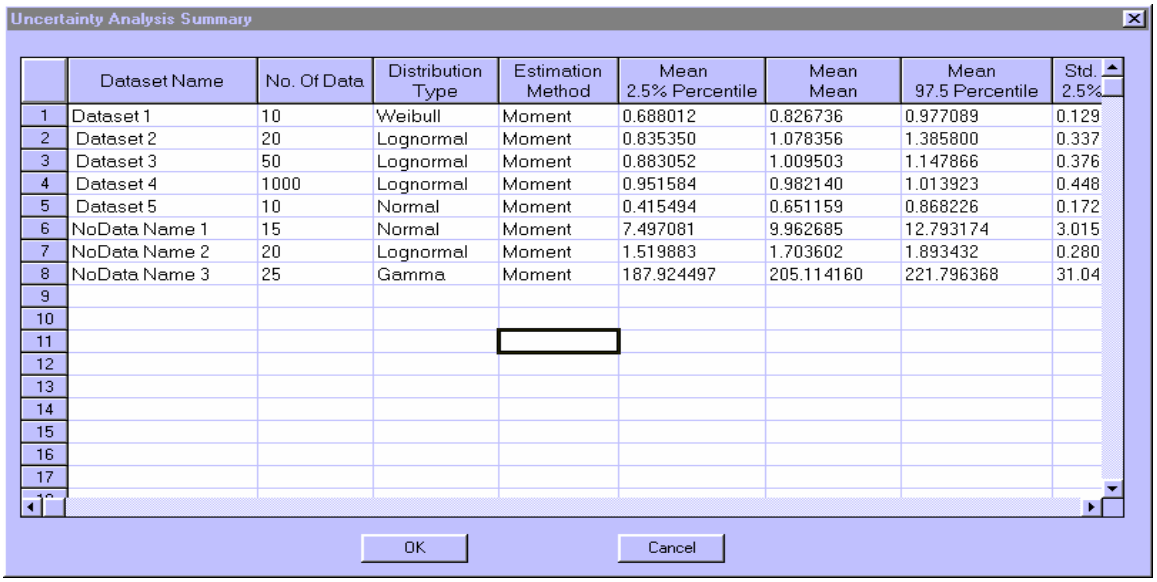
- Click the OK button on the ***Variability Analysis: Fitting Distribution Summary*** window.
- Click the Cancel button on the ***Variability Analysis: Fitting Distribution Summary*** window.

15.0 UNCERTAINTY ANALYSIS RESULT REPORTING

AuvTool reports three types of uncertainty analysis results. They are: (1) summary of the uncertainty in the mean and standard deviation; (2) summary of the parametric distributions fitted to the sampling distribution data for the statistics of interest; and (3) summary of results in a format specially used for EPA's SHEDS model.

15.1 Reporting Uncertainty in the Mean and Standard Deviation

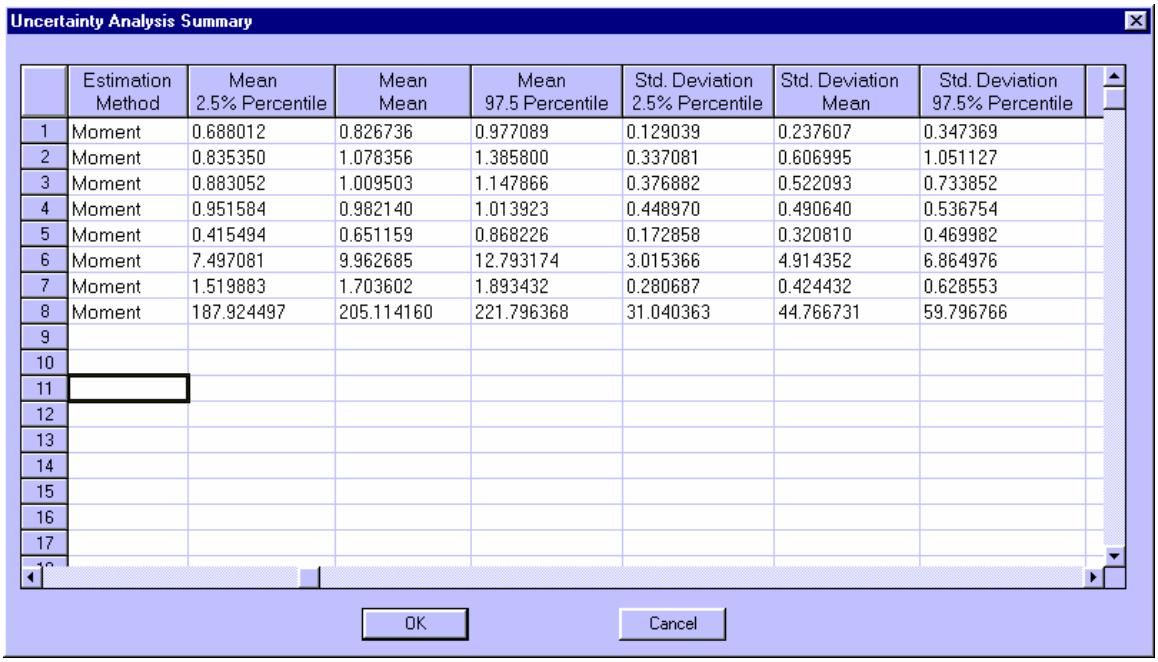
You can get a report regarding uncertainty in the mean and standard deviation by clicking on the Uncertainty Result Summary… button on the left-bottom of the ***Batch Fitting*** window. The program will display an ***Uncertainty Analysis Summary*** window such as the example below.



	Dataset Name	No. Of Data	Distribution Type	Estimation Method	Mean 2.5% Percentile	Mean Mean	Mean 97.5 Percentile	Std. 2.5%
1	Dataset 1	10	Weibull	Moment	0.688012	0.826736	0.977089	0.129
2	Dataset 2	20	Lognormal	Moment	0.835350	1.078356	1.385800	0.337
3	Dataset 3	50	Lognormal	Moment	0.883052	1.009503	1.147866	0.376
4	Dataset 4	1000	Lognormal	Moment	0.951584	0.982140	1.013923	0.448
5	Dataset 5	10	Normal	Moment	0.415494	0.651159	0.868226	0.172
6	NoData Name 1	15	Normal	Moment	7.497081	9.962685	12.793174	3.015
7	NoData Name 2	20	Lognormal	Moment	1.519883	1.703602	1.893432	0.280
8	NoData Name 3	25	Gamma	Moment	187.924497	205.114160	221.796368	31.04
9								
10								
11								
12								
13								
14								
15								
16								
17								

Uncertainty Analysis Summary window (1)

It may take a while to get the reports, which depends on the speed of your computer, the number of datasets you are analyzing, the bootstrap simulation parameter values, and which parameter estimation method is used.



Uncertainty Analysis Summary window (2)

15.1.1 Brief Explanation of Columns

The following gives a brief introduction to the columns inside the ***Uncertainty Analysis Summary*** window:

Dataset Name: The variable or data set name is given for the variables you analyzed.

No. of Data The number of data points for each data set is given.

Distribution Type: The distribution type used to represent the variability for the corresponding variable or data set is shown.

Estimation Method: The parameter estimation method used to estimate the parameters for the bootstrap samples is given, either MLE or MoMM.

Mean | 2.5% Percentile: The 2.5th percentile of the sampling distribution of the mean is given. This is the lower bound on the 95 percent confidence interval for the mean.

Mean | Mean: The mean of the sampling distribution of the mean is given.

Mean | 97.5% Percentile: The 97.5th percentile of the sampling distribution of the mean is given. This is the upper bound on the 95 percent confidence interval for the mean.

Standard Deviation | 2.5% Percentile: The 2.5th percentile of the sampling distribution of the standard deviation is given. This is the lower bound on the 95 percent confidence interval for the standard deviation.

Standard Deviation | Mean: The mean of the sampling distribution of the standard deviation is given.

Standard Deviation | 97.5% Percentile: The 97.5th percentile of the sampling distribution of the standard deviation is given. This is the upper bound on the 95 percent confidence interval for the standard deviation.

15.1.2 Exporting The Uncertainty Analysis Summary Table

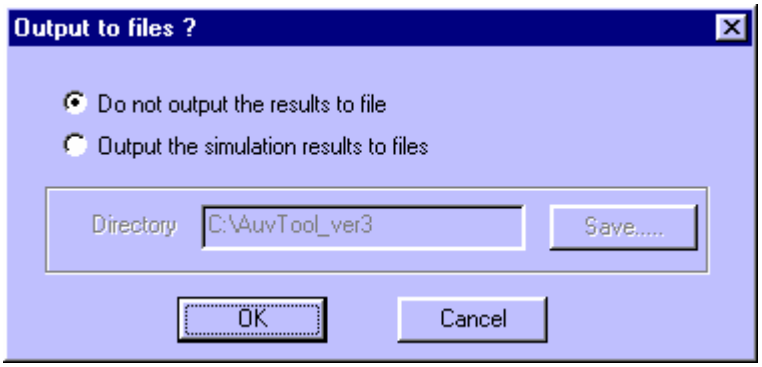
You can export the uncertainty analysis results to other file formats or to other applications. You can copy, save and export the uncertainty analysis results summary sheet. For more information on how to do this, please see the section on "Working with a Sheet" on page 96.

15.2 Reporting the Summary of the Fitted Parametric Distributions to Sampling Distribution Data for Statistics of Interest

You can get summary reports for the results of fitting parametric distribution to sampling distribution data for statistics of interest by clicking on the Uncertainty Sampling Summary… button on the right-bottom of the ***Batch Fitting*** window or by clicking on the Uncertainty Distribution Summary button on the right-bottom corner of the "***Fitting Uncertainty Sampling Distribution*****"** page of the ***Bootstrap Simulation*** window.

Before the program will display the ***Summary on Uncertainties in Mean, Std. Deviation and Other Statistics*** window, first it will popup an ***Output to files?*** dialog box to prompt users as to whether the simulation results will be output to files. By default, the program assumes that users are not planning to output the analysis results to files here. If users want to output the results to files, select the **output the simulation results to files** labeled radio box by clicking on it, and enter the directory and file names that the analysis results will be output to. The program will automatically save the analysis results in the format of the EPA SHEDS model to the files after the simulations are finished. The files will include two types of file formats: Excel ™ and Tab-Delimited text files.

Note: Even if users do not choose to output the simulation results to files here, they still can save the analysis results after the ***Summary on Uncertainties in mean, std. Deviation and other statistics*** window shows up. Users can export the analysis results through the methods discussed in the section on "Working with Sheet" on page 96.



Output to files Dialog

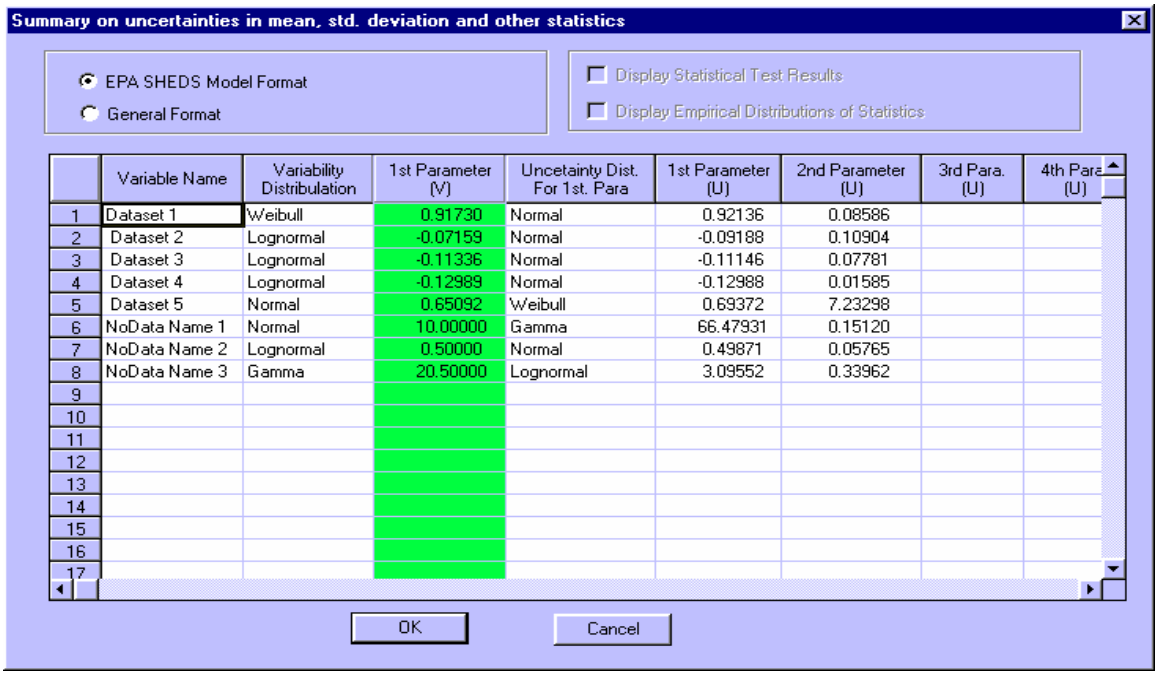
After the ***Output to files?*** dialog box disappears, it may take a while to get the reports. The time involved depends on the speeds of your computer, the number of data sets you are analyzing, which parameter estimation method is used, and the bootstrap simulation parameters. When all relevant calculations are done, the program will display the ***Summary on Uncertainties in Mean, Std. Deviation and Other Statistics*** window. Inside the window, there are two kinds of sheets. One presents the analysis results on the sampling distribution data especially for EPA SHEDS model use; another contains the results in a general format. By default, the program will show the sheet for the EPA SHEDS model format.

15.2.1 Brief Explanation of Columns inside the Sheet of EPA SHEDS Model Format

As shown in the two figures on the next page, the main columns are explained below:

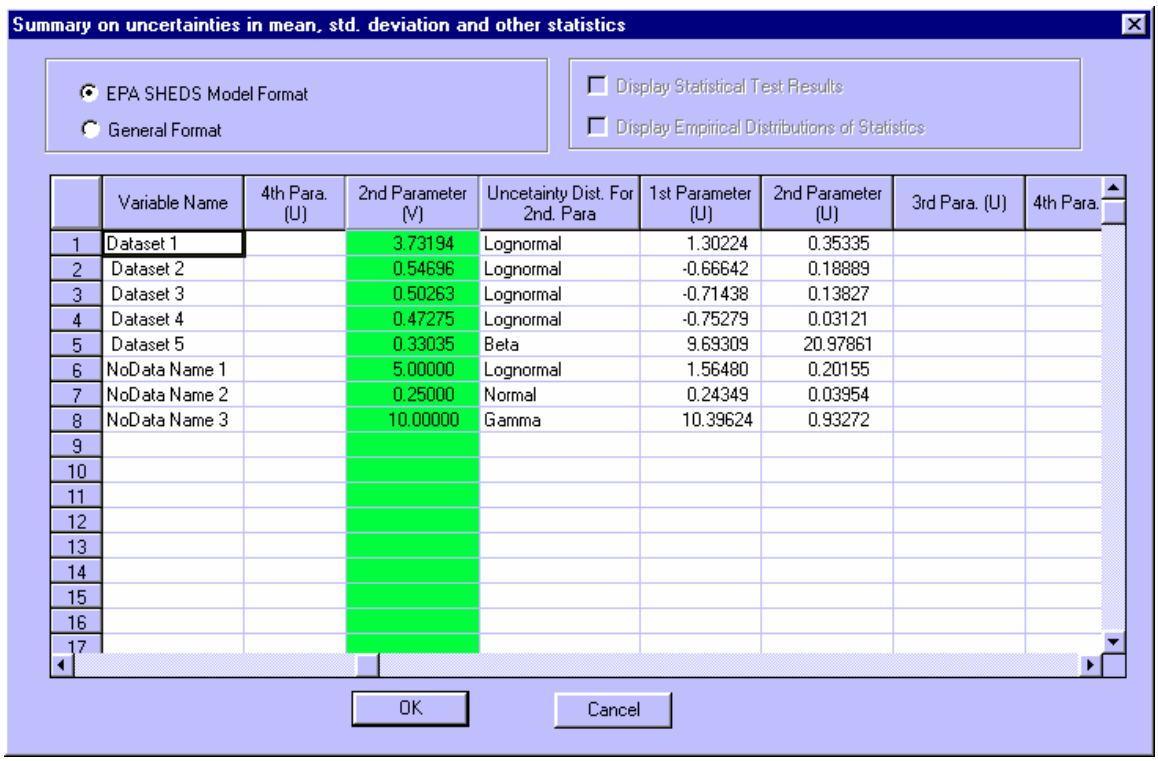
Variable Name: The variable names for the variables you analyzed.

Variability Distribution: The distribution type used to represent variability for the variable.



	Variable Name	Variability Distribulation	1st Parameter (V)	Uncetainty Dist. For 1st. Para	1st Parameter (U)	2nd Parameter (U)	3rd Para. (U)	4th Para (U)
1	Dataset 1	Weibull	0.91730	Normal	0.92136	0.08586		
2	Dataset 2	Lognormal	-0.07159	Normal	-0.09188	0.10904		
3	Dataset 3	Lognormal	-0.11336	Normal	-0.11146	0.07781		
4	Dataset 4	Lognormal	-0.12989	Normal	-0.12988	0.01585		
5	Dataset 5	Normal	0.65092	Weibull	0.69372	7.23298		
6	NoData Name 1	Normal	10.00000	Gamma	66.47931	0.15120		
7	NoData Name 2	Lognormal	0.50000	Normal	0.49871	0.05765		
8	NoData Name 3	Gamma	20.50000	Lognormal	3.09552	0.33962		
9								
10								
11								
12								
13								
14								
15								
16								
17								

EPA SHEDS Model Format Sheet (1)



	Variable Name	4th Para. (U)	2nd Parameter (V)	Uncetainty Dist. For 2nd. Para	1st Parameter (U)	2nd Parameter (U)	3rd Para. (U)	4th Para.
1	Dataset 1		3.73194	Lognormal	1.30224	0.35335		
2	Dataset 2		0.54696	Lognormal	-0.66642	0.18889		
3	Dataset 3		0.50263	Lognormal	-0.71438	0.13827		
4	Dataset 4		0.47275	Lognormal	-0.75279	0.03121		
5	Dataset 5		0.33035	Beta	9.69309	20.97861		
6	NoData Name 1		5.00000	Lognormal	1.56480	0.20155		
7	NoData Name 2		0.25000	Normal	0.24349	0.03954		
8	NoData Name 3		10.00000	Gamma	10.39624	0.93272		
9								
10								
11								
12								
13								
14								
15								
16								
17								

EPA SHEDS Model Forma Sheet (2)

1st Parameter (V): The estimated first parameter in the case of a parametric distribution for the distribution representing variability.

Uncertainty Dist. For 1st Para.: The parametric distribution type describing the sampling distribution data for the estimated first parameter.

1st Parameter (U): The estimated first parameter for the parametric distribution describing the sampling distribution for the first or second parameter of the variability distribution.

2nd Parameter (U): The estimated second parameter for the parametric distribution describing the sampling distribution for the first or second parameter of the variability distribution.

2nd Parameter (V): The estimated second parameter in the case of a parametric distribution for the distribution representing variability.

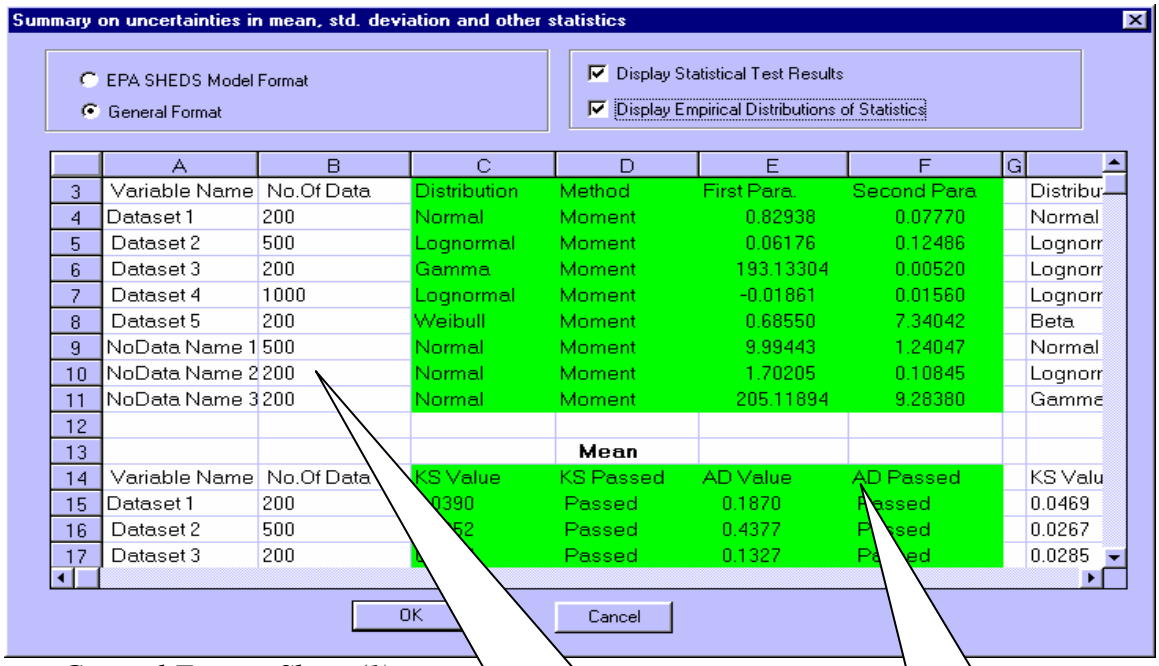
Uncertainty Dist. For 2nd Para.: The parametric distribution type describing the sampling distribution data for the estimated second parameter.

3rd or 4th Parameter (V) or (U): not available for the current version of AuvTool.

Note: For the definitions of 1st parameter and 2nd parameter, please refer to the section on "AuvTool Convention" on page 18.

15.2.2 Brief Explanation of Columns inside the Sheet of General Format

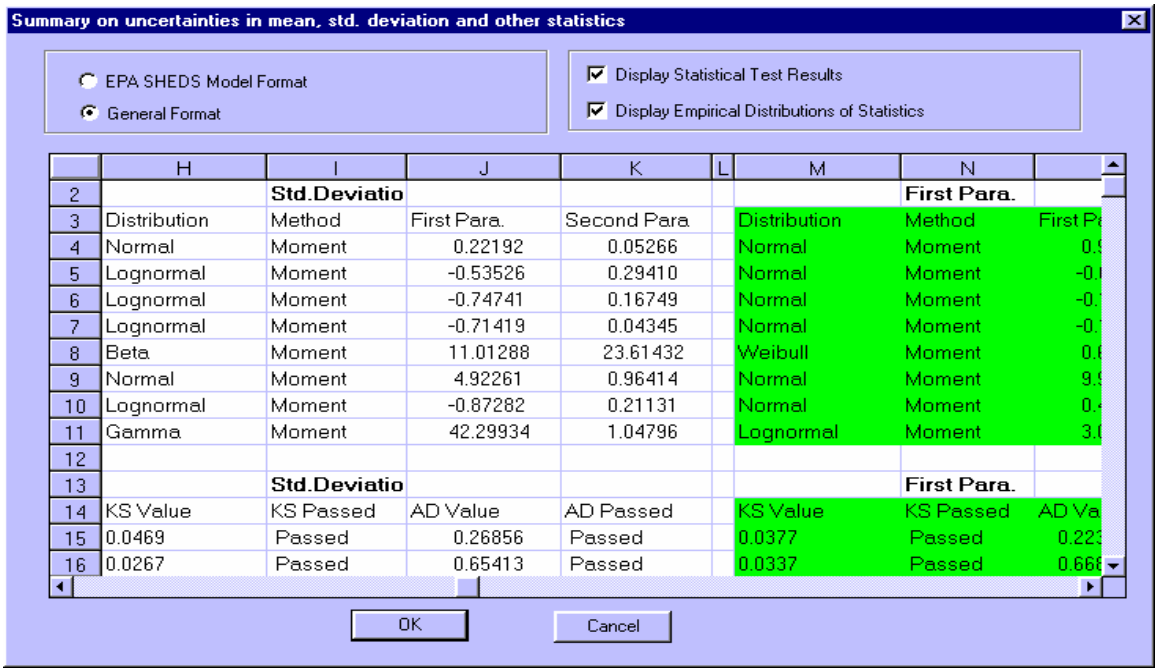
As shown in the following four figures, the general format presents three parts of the analysis results. The first part shows the distribution information used to describe the presented by default. The second part shows the goodness-of-fit statistical test results for



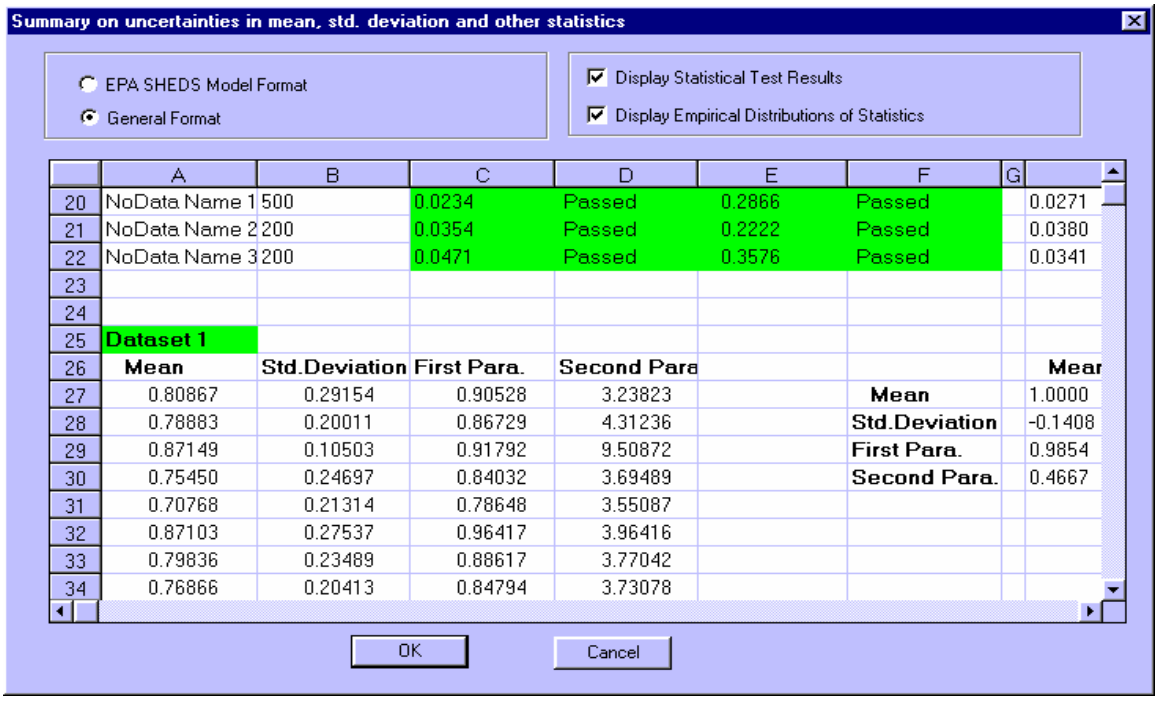
General Format Sheet (1)

Distribution information about the statistics

Statistical test results

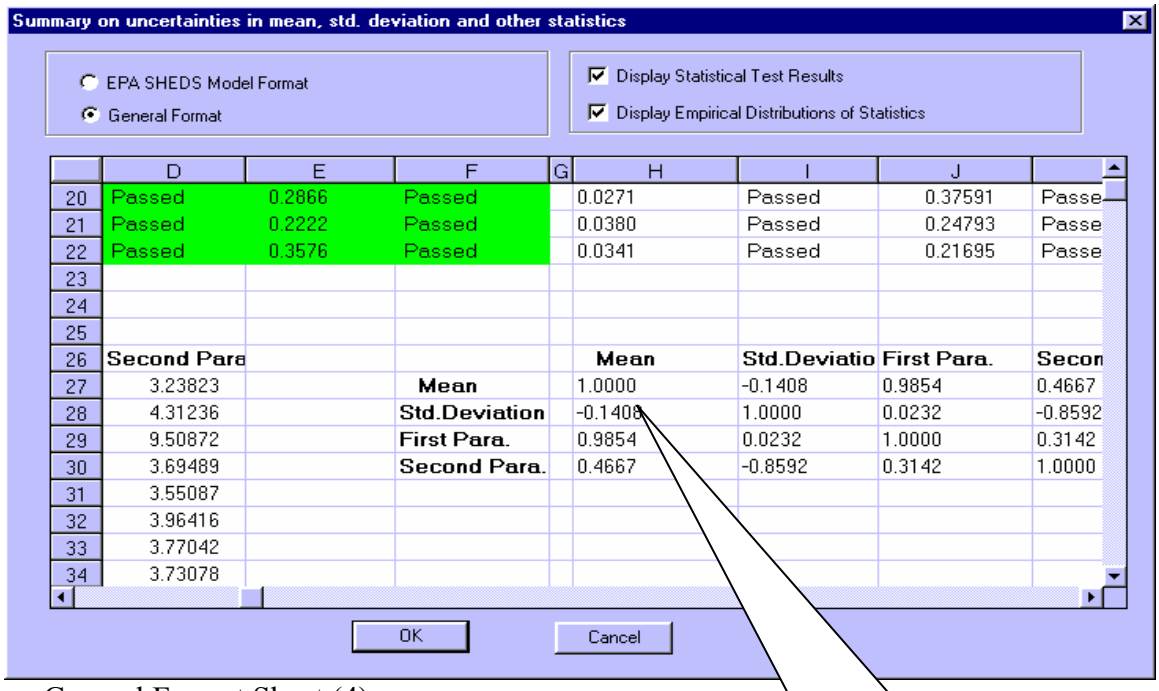


General Format Sheet (2)



	A	B	C	D	E	F	G	
20	NoData Name 1	500	0.0234	Passed	0.2866	Passed		0.0271
21	NoData Name 2	200	0.0354	Passed	0.2222	Passed		0.0380
22	NoData Name 3	200	0.0471	Passed	0.3576	Passed		0.0341
23								
24								
25	**Dataset 1**							
26	**Mean**	**Std.Deviation**	**First Para.**	**Second Para**				**Mear**
27	0.80867	0.29154	0.90528	3.23823		**Mean**		1.0000
28	0.78883	0.20011	0.86729	4.31236		**Std.Deviation**		-0.1408
29	0.87149	0.10503	0.91792	9.50872		**First Para.**		0.9854
30	0.75450	0.24697	0.84032	3.69489		**Second Para.**		0.4667
31	0.70768	0.21314	0.78648	3.55087				
32	0.87103	0.27537	0.96417	3.96416				
33	0.79836	0.23489	0.88617	3.77042				
34	0.76866	0.20413	0.84794	3.73078				

General Format Sheet (3)



	D	E	F	G	H	I	J	
20	Passed	0.2866	Passed		0.0271	Passed	0.37591	Passe
21	Passed	0.2222	Passed		0.0380	Passed	0.24793	Passe
22	Passed	0.3576	Passed		0.0341	Passed	0.21695	Passe
23								
24								
25								
26	**Second Para**				**Mean**	**Std.Deviatio**	**First Para.**	**Secon**
27	3.23823		**Mean**		1.0000	-0.1408	0.9854	0.4667
28	4.31236		**Std.Deviation**		-0.1408	1.0000	0.0232	-0.8592
29	9.50872		**First Para.**		0.9854	0.0232	1.0000	0.3142
30	3.69489		**Second Para.**		0.4667	-0.8592	0.3142	1.0000
31	3.55087							
32	3.96416							
33	3.77042							
34	3.73078							

General Format Sheet (4)

The pair-wise sampling data and correlation matrix

the corresponding distributions fitted to the sampling distribution data for the statistics of the mean, standard deviation, distribution parameters. The second part will be shown if the **Display the Statistical Test Results** labeled check box is selected. The third part will display pair-wise sampling data for all four statistics of interest and for each variable, and the correlation between the statistics for each variable. As an example, the columns covering the mean statistic are explained below. The columns covering the other statistics have the same explanations.

Variable Name: The variable names for the variables you analyzed.

No. of Data Points: The number of sampling distribution data for the statistics. The number is the same number as bootstrap replications.

Distribution: The parametric distribution type used to represent the sampling distribution of the mean.

Method: The estimation method used to estimate the parameters for the distribution fitted to the sampling distribution data. These include two estimation methods, MLE and MoMM, which are marked as " MLE" and "Moment," respectively, at the corresponding cells.

First Para. and **Second Para.:** The parameters for the distribution fitted to the sampling distribution data for a statistic. Please see the "Distribution Definitions and AuvTool Conventions" on page 18 for more details.

KS Value: The K-S test statistic value for the distribution fitted to the sampling distribution data for the mean.

AD Value: The Anderson-Darling test statistic value for the distribution to to the sampling distribution data for the mean. Since the test is not available for

beta, uniform and symmetric triangle distributions, the values will be reported as "0.0" or "-1.0" in these cases.

KS Passed: If the K-S test was passed, the corresponding cell will be marked as "Passed". If the K-S test was failed, it will be marked as "Failed." If no information is available, the cell will be reported as "NA."

AD Passed: If the A-D test was passed, the corresponding cell will be marked as "Passed". If the A-D test was failed, it will be marked as "Failed." If no information is available, the cell will be reported as "NA."

15.2.3 Switching Between the EPA SHEDS Model Format Sheet and The General Format Sheet

To switch between the EPA SHEDS Model Format and the General Format, select the appropriate radio button on the left-top of the ***Summary on Uncertainties in Mean, Std. Deviation and Other Statistics*** window.

If the AuvTool program is displaying the EPA SHEDS format sheet, click on the **General Format** labeled radio button. The program will switch to show the sheet of the general format.

If the AuvTool program is displaying the general format sheet, click on the **EPA SHEDS Model Format** labeled radio button. The program will switch to show the sheet of EPA SHEDS model format.

15.2.4 Exporting the Summary Tables

You can export the analysis results of the sampling distribution data obtained from bootstrap simulation, provided either in the sheets of the EPA SHEDS model format

or the general format, to other file formats or to your applications. You can copy, save and export the both summary sheets. For more information on how to do this, please see the section on "Working with a Sheet" on page 96.

16.0 WORKING WITH A SHEET

In this section we describe how to work with a spreadsheet, including: (1) copying and pasting between AuvTool and application programs such as Excel ™; (2) printing out a sheet; and (3) exporting a sheet to other file formats. All of these operations are the same in all modules associated with a spreadsheet. As an example, we will use the sheet in the ***Variability Analysis: Fitting Distribution Summary*** window to help explain how to work with a sheet. The same procedure can be used in other modules such as the "Link Distribution" module, and the "Batch Analysis" module.

16.1 Copying

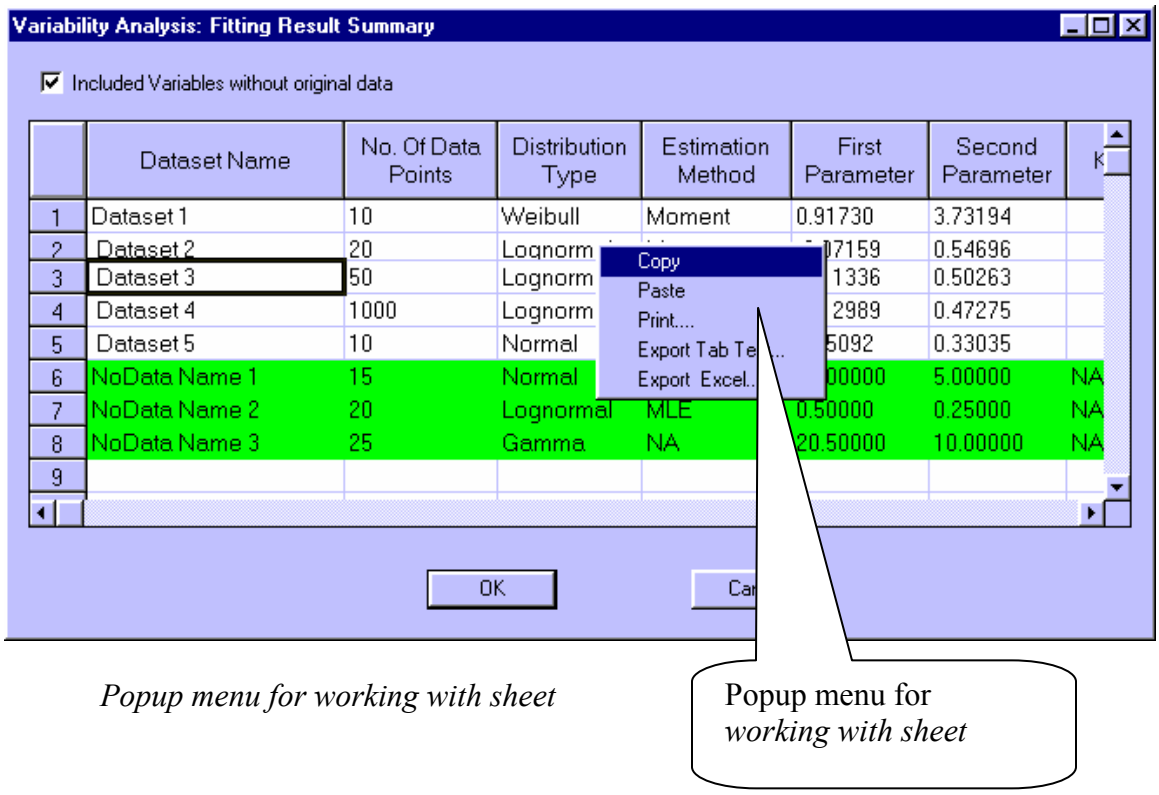
To copy data from a spreadsheet:

- Select the cells that you want to copy
- Click the right mouse button within the range of a sheet. The program will popup a menu as shown in the window on the next page:
- Release the right button, drag the pointer to **Copy**, and click on it by pressing the left mouse button.

16.2 Pasting

To paste data from a spreadsheet:

- Select the cells that you want to paste data into.
- Click the right mouse button within the range of a sheet. The program will popup the *Working with Sheet* menu.



Popup menu for working with sheet

- Release the right button, drag the pointer to **Paste**, and click on it by pressing the left mouse button.

16.3 Printing a Sheet

To print out a spreadsheet:

- Click the right mouse button within the range of a sheet. The program will popup the *Working with Sheet* menu.
- Release the right button, drag the pointer to **Print**, and click on it by pressing the left mouse button.

Note: The AuvTool does not provide a strong feature of formatted printing. You might not be satisfied with the format of output when you printed directly from AuvTool. If you need more advanced print features, we recommend that you

export the AuvTool spreadsheet results to Microsoft Excel ™, where you can have more control over the format.

16.4 Exporting a Sheet to Tab-Delimited Text File

To export a spreadsheet to a tab-delimited text file:

- Click the right mouse button within the range of a sheet. The program will popup the *Working with Sheet* menu.
- Release the right button, drag the pointer to **Export Tab-Delimited…**, and click on it by pressing the left mouse button. The program will display a *Save as* file dialog box with the initial file type of ".txt".
- Enter a filename with an extension of ".txt". Click the Save button in the *Save as* dialog box.

16.5 Exporting a Sheet to a Microsoft Excel File

To export a spreadsheet to a Excel ™ file:

- Click the right mouse button within the range of a sheet. The program will popup the *Working with Sheet* menu.
- Release the right button, drag the pointer to **Export Excel…**, and click on it by pressing the left mouse button. The program will display a *Save as* file dialog box with the initial file type of ".xls".
- Enter a filename with an extension of ".xls". Click the Save button in the *Save as* dialog box.

Note: When you save a file, you can save the file to any other directory you want. Just select the drive letter and the directory you want to save to in the Directories box. You can also save the file to a floppy disk. In order to do that, just change the drive to the drive letter of your disk.

17.0 WORKING WITH A GRAPH

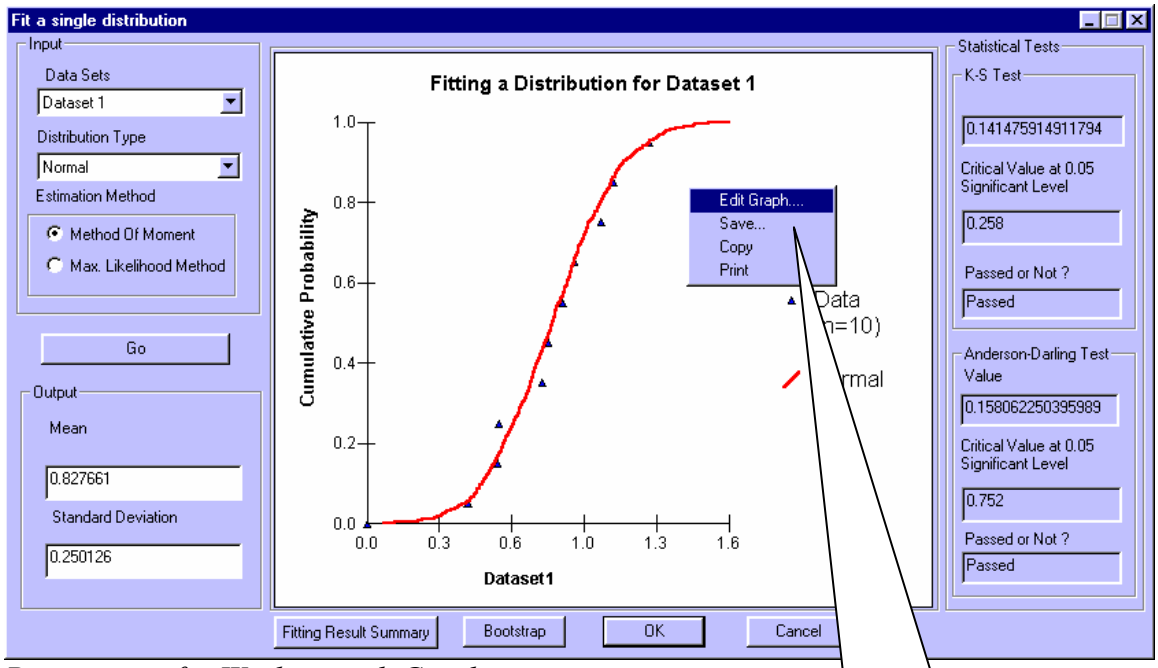
In this section we describe how to work with a graph, including editing a graph, saving a graph into a file, copying a graph to other window applications, and printing a graph. All of these operations are the same in all modules. As an example, we will use the ***Fit a Single Distribution*** window in the "Variability Analysis: Fitting Distribution Dataset by Dataset*"* module to help explain how to work with a graph. The same procedure can be used in other modules such as the "Uncertainty Analysis: Bootstrap Simulation*"* module, and any other modules which have a graph.

17.1 Switching between the *Working with Graph* Popup Menu and *Graph Control* Dialog Box

Whenever you click the right mouse button within the range of a graph for the first time, the program will popup a *Working with Graph* menu as shown in the window below:

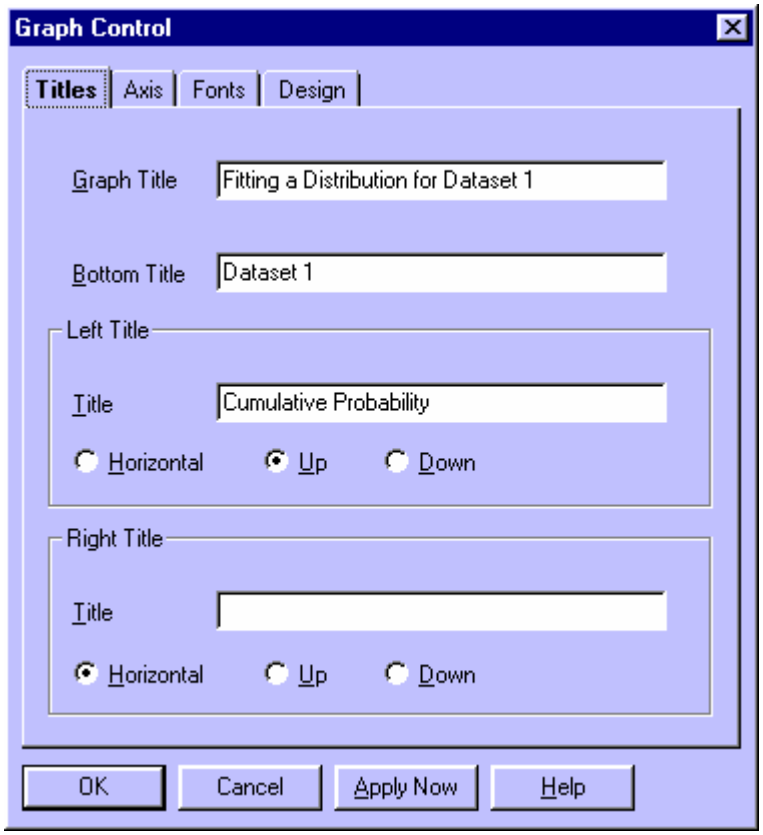
Release the right button, drag the pointer to **Edit Graph…**, click on the item by pressing the left mouse button, and then click on the right mouse button again. The program will popup *a* ***Graph Control*** dialog box shown on the next page. There are four pages within the box: they are the "***Titles"*** page, "***Axis"*** page, "***Fonts"*** page and "***Design"*** page.

When you click the OK or Cancel button within the ***Graph Control*** dialog box, the program will exit the box. However, when you click the right mouse button again within the range of the graph, the program will always popup **the** ***Graph Control*** dialog box. If you want to switch to the *Working with Graph* popup menu for other operations



Popup menu for Working with Graph

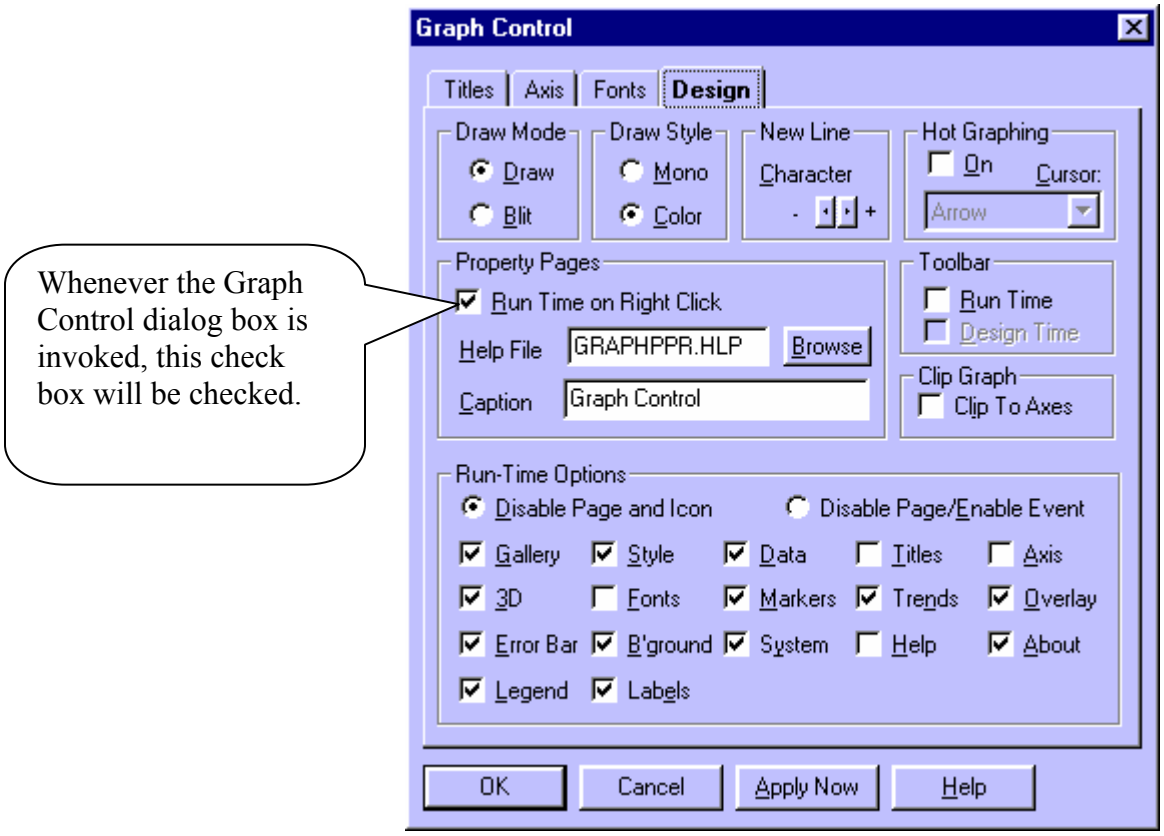
Working with Graph popup menu



Graph Control dialog box

such as copying, printing and saving a graph when you click the right mouse button, you need to follow the steps listed below:

- Click the Design tab within the ***Graph Control*** dialog box. The program will go to the "***Design"*** page shown below:



Design page within the *Graph Control* dialog box

- Uncheck the **Run Time on Right Click** labeled check box in the **Property Pages** group by clicking on it.
- Click the OK button at the bottom of the ***Graph Control*** dialog box to exit the box.
- Click the right mouse button, and the program will popup the *Working with Graph* menu as previously shown. You can return to the ***Graph***

Control dialog box as introduced at the beginning of this subsection, or you can go to other options for saving, copying and printing a graph.

Note: You do not need to modify other control options in the "***Design"*** page within the ***Graph Control*** dialog box; and you do not need to use other options provided in the "***Design"*** page. Therefore, no detail is provided here regarding the "***Design"*** page.

17.2 Editing a Graph

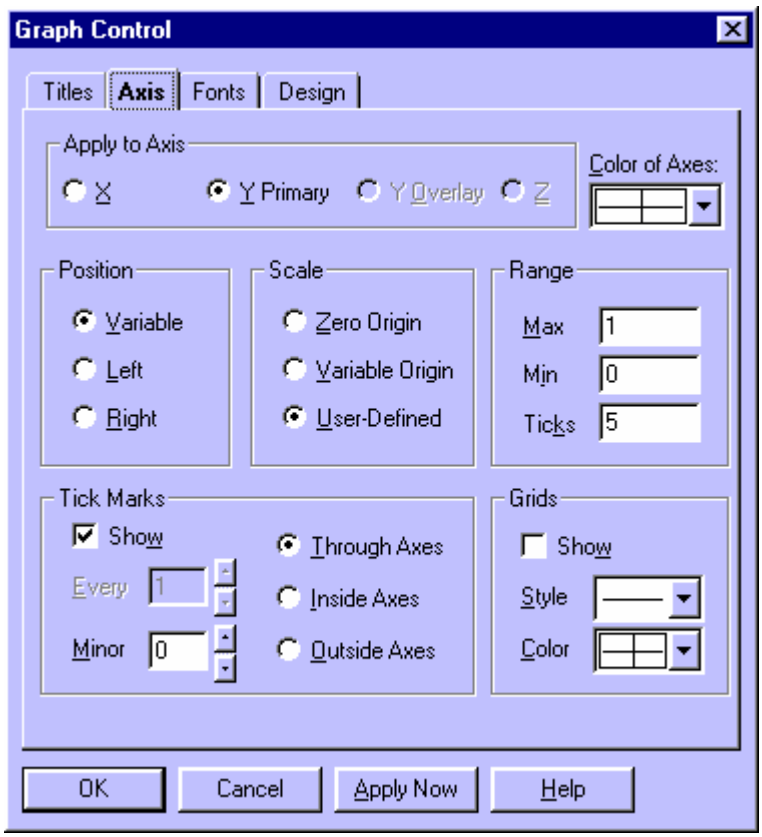
You can edit an AuvTool graph by changing the scale of an axis, titles of the graph, and fonts for displaying the titles and legends.

17.2.1 Editing Axes

By using the editing axes feature, you can edit the axes of a graph, including changing the scale of axes, changing the number of tick marks and changing the display of axes. To invoke the feature: first bring up the ***Graph Control*** dialog box, as introduced above, and then click on the Axis tab to enable the ***Axis*** page, which is shown on the next page:

Introduction to the Controls within the "***Axis"*** Page

The "**Axis**" page has several groups of input fields in a variety of formats. These groups include: (1) "Apply to Axis" at the top of the page; (2) "Position" at the left side under the "Apply to Axis" group; (3) "Scale" next to the "Position" group near the center of the page; (4) "Range" next to the "Scale" group on the right senter of the page; (5)



Axis page within *Graph Control* dialog

"Tick Marks" on the lower left hand position of the page; and (6) " Grids" on the lower right hand position of the page. Each of these groups is described in detail.

Apply to Axis *Group*

X labeled radio box: Select this option to view and/or change the settings for the X axis.

Y Primary labeled radio box: Select this option to view and/or change the settings for the Y axis (there is the only one Y axis when you do not have an overlay graph).

Color of Axes labeled combo list box: In this list box you can choose a color for the axes from the current color palette. The same color is

applied to all axes. The default color is automatic black or white, whichever provides more contrast.

Position *Group*

Variable labeled radio box: When the **X** axis is selected in the **Apply to Axis** group, select this option to draw the **X** axis intersecting the **Y** origin, whether that is at the top, bottom, or middle of the graph. When **Y Primary** is selected in the **Apply to Axis** group, select this option to draw the primary **Y** axis intersecting the **X** origin, whether that is at the left, right, or middle of the graph.

Left or **Top** labeled radio box: When **X** is selected in the **Apply to Axis** group, select this option to draw the **X** axis at the top of the graph, regardless of the location of the **Y origin**. When **Y Primary** is selected in the **Apply to Axis** group, select this option to draw the primary **Y** axis at the left edge of the graph, regardless of the location of the **X origin**.

Right or **Bottom** labeled radio box: When **X** is selected in the **Apply to Axis** group, select this option to draw the **X** axis at the bottom of the graph, regardless of the location of the **Y origin.** When **Y Primary** is selected in the **Apply to Axis** group, select this option to draw the primary **Y** axis at the right edge of the graph, regardless of the location of the **X origin**.

***Scale** Group*

Zero Origin labeled radio box: Select this option to draw the axes to include the origin (zero) and to extend far enough in the positive and negative directions so as to include all of the graph's values.

Variable Origin labeled radio box: Select this option to have the axes "zoom in" on the range of the graph's actual values, whether or not that range includes origin.

User-Defined labeled radio box in the **Scale** group: Select this option to set your own values for the minimum, maximum, and number of ticks for the axis. When you select **User-Defined**, the settings in the **Range** group are enabled.

***Range** Group*

Max, **Min** and **Ticks** edit boxes: The settings are enabled only when you select the **User-Defined** labeled radio box in the **Scale** group. These edit boxes are used to set the maximum point, minimum point and the number of ticks for the selected axis.

***Tick Marks** Group*

Show labeled check box: Check this box to draw tick marks along the axis. Clear the box for no tick marks.

Every labeled edit box in the **Tick Marks** group: If you select **Zero Origin** or **Variable Origin** in the **Scale** group, you can use the

Every setting to specify the frequency with which tick marks are displayed along the **X** axis. An **Every** setting of *1* places a mark at each tick, a setting of *2* places a mark at every other tick, and so on. The **X** axis must end with a tick mark. If you set an **Every** value that does not include the last value on the axis, the *Graph Control* will extend the axis so that it ends on a tick mark.

Minor labeled edit box: Specify the number of minor tick marks to be drawn between pairs of major ticks.

Through Axes labeled radio box: Select this option if you want tick marks centered on the axis line.

Note: Your selection will apply to all axes for which tick marks have been enabled.

Inside Axes labeled radio box: Select this option if you want tick marks to be drawn only on the graph side of the axes.

Note: Your selection will apply to all axes for which tick marks have been enabled.

Outside Axes labeled radio box: Select this option if you want tick marks drawn outside the axes.

Note: Your selection will apply to all axes for which tick marks have been enabled.

***Grids** Group*

Show labeled check box: Select this option to draw grid lines perpendicular to the axis, intersecting each tick mark. Clear the

box for no grid lines.

Style labeled combo list box (default is solid): In this list box, you can choose a style for grid lines. The same style is applied to both X and Y grids.

Color labeled combo list box: In this list box, you can choose a color for grids from the current palette. The same color is applied to both X and Y grids. The default color is automatic black or white, whichever provides more contrast.

Editing the Axes of a Graph

You can edit the display of axes to your preference. For example, if you enter the following:

Maximum of X axis: 2.0

Minimum of X axis: 0.0

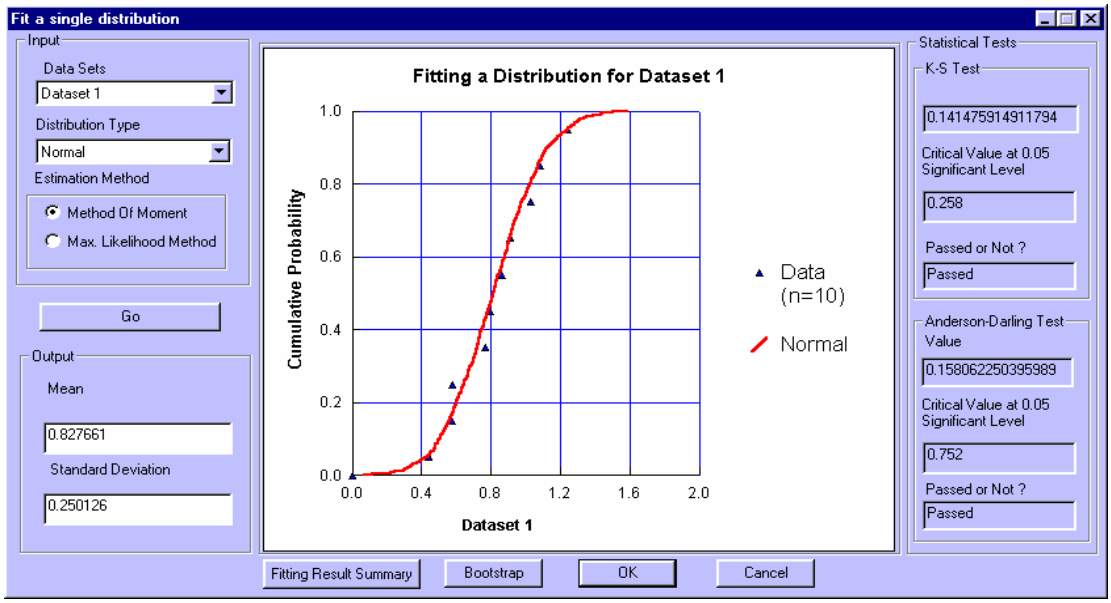
Check the **Show** labeled check box in the Grids group for both X axis and Y axis,

Select *Blue* in the **Color** labeled combo list box in the **Grids** group, and

Select the **Inside Axes** labeled radio box in the **Tick Marks** group,

If other options are unchanged; when you click the Apply Now button or the Ok button (The difference is that the ***Graph Control*** dialog box will not exit when you click the Apply Now button); the graph will be automatically updated as follows:

Note 1: In the "***Axis"*** page within ***Graph Control*** dialog box, you may enter minimum and maximum values for the X-Axis and the Y-Axis. For a cumulative



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distribution function, it is recommended that you do not change the Y-Axis minimum from zero or the Y-Axis maximum from 1. For the X-Axis, you may type in the minimum and maximum values that you prefer.

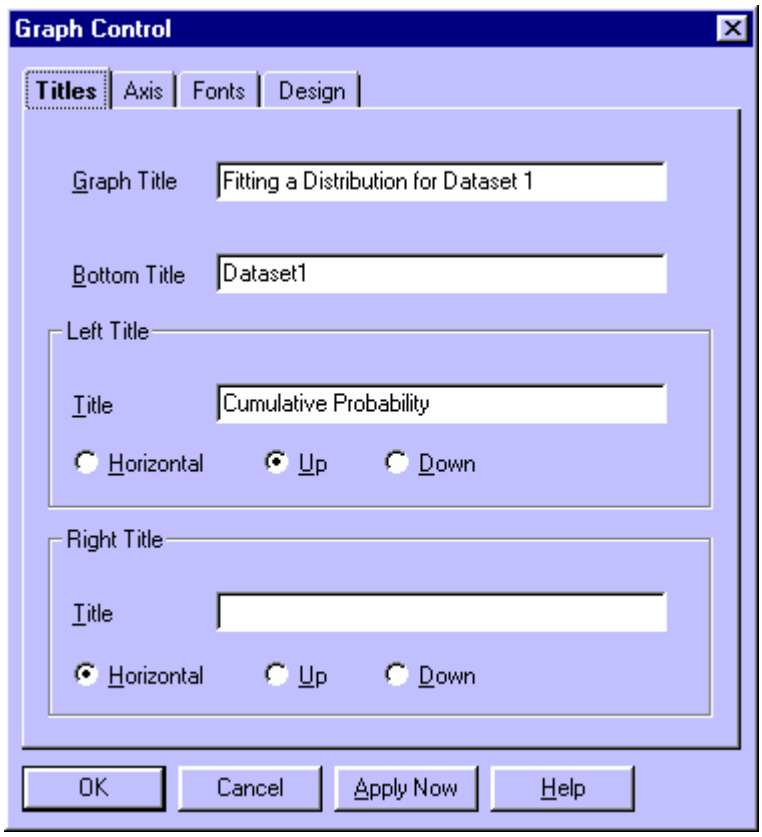
Note 2: If you wish to abandon your entries, click the Cancel button. The ***Graph Control*** dialog box will disappear and no change will be made to the graph.

17.2.2 Editing Titles

By using the "**Title**" feature, you can enter or modify the graph title, the bottom title, and the left and right titles. You can also adjust the display direction of the left and right titles. To invoke the feature: first bring up the ***Graph Control*** dialog box, as introduced in the first section of this chapter, and then click on the Titles tab in the ***Graph Control*** dialog box to enable the "***Titles"*** page, which is shown on the next page.

Introduction to the Controls within "***Titles"*** Page

Graph Title labeled edit box: In this box, you can enter or modify text for the graph title, which can be up to 80 characters in length. This title appears centered at the top of the graphing window.



The ***Titles*** page within the *Graph Control* box

Bottom Title labeled edit box: In this box, you can enter or modify text for the bottom title, which can be up to 80 characters in length. This title appears centered at the bottom of the graphing window. A bottom title frequently explains the X axis.

Left Title *group* (often used to explains the Y Axis)

The **Title** edit box lets you enter text for the left title, which can be up to 80 characters in length.

Horizontal labeled radio box: Elect this option if you want the title to print horizontally.

Up labeled radio box: Select this option if you want the title to print vertically, running in an upward direction. (In AuvTool, this is default option)

Down labeled radio box: Select this option if you want the title to print vertically, running in a downward direction.

Right Title *group*

The **Title** edit box lets you enter text for the right title, which can be up to 80 characters in length. The right title frequently explains the right-hand Y axis when you have an overlay graph.

Horizontal labeled radio box: Select this option if you want the title to print horizontally.

Up labeled radio box: Select this option if you want the title to print vertically, running in an upward direction. (In AuvTool, it is default option)

Down labeled radio box: Select this option if you want the title to print vertically, running in a downward direction.

Note: When you enter text for a title, the Graph Control adjusts the rest of the graph window to provide space either by redrawing the graph and associated objects at a

smaller size or by decreasing the space between objects. When you clear the text box for a title, you disable it and provide more space for the rest of the graph. If you enter a title that is too long to appear in a single line, the Graph Control automatically word-wraps it. If a title does not display at all, it is because the Graph Control can not make the font small enough to fit all the text in the space provided.

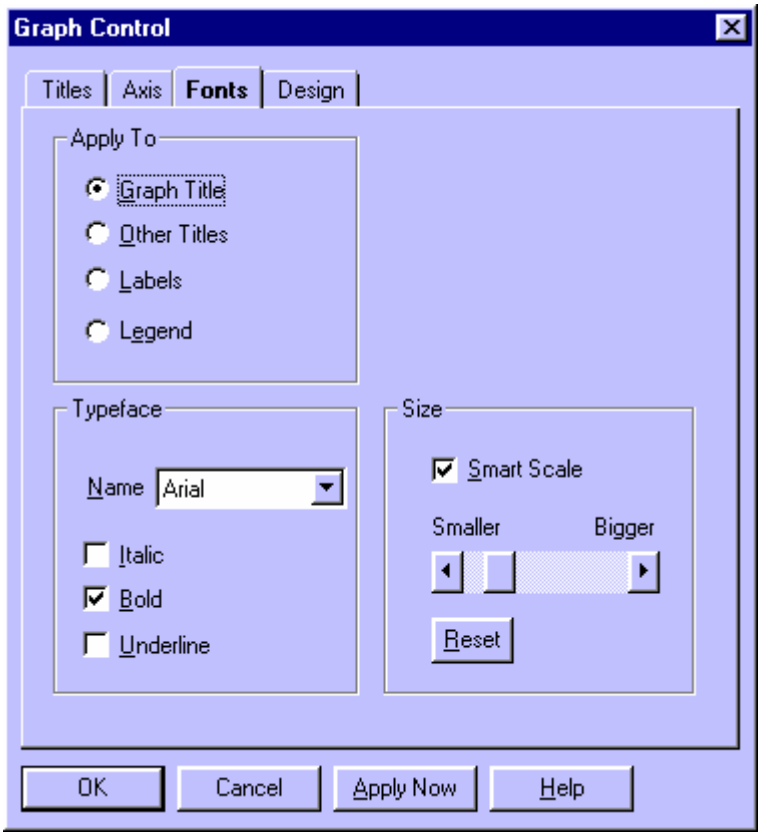
Editing the Titles of a Graph

Based on the above discussions, you can enter or modify the titles of a graph. When you finish your editing, click the Apply Now or Ok buttons (The difference is that the ***Graph Control*** dialog box will not exit when you click the Apply Now button.) The graph will be automatically refreshed. If you want to abandon your editing, click the Cancel button. The ***Graph Control*** dialog box will disappear and no change will be made to the titles of a graph.

Note: It is recommended that you do not change any setting for the **Left Title** group in the AuvTool. You also do not need to edit the **Right Title** group in AuvTool.

17.2.3 Editing Fonts

AuvTool allows users to change the style and size of fonts for graph titles, other titles, labels and legend. To invoke the feature: first bring up the ***Graph Control*** dialog box, as introduced in first section of this chapter on page 100, and then click on



The ***Fonts*** page within the *Graph Control* dialog box

the Fonts tab in the ***Graph Control*** dialog box to enable the "***Fonts"*** page, which is shown above:

Introduction to the Controls within the "***Fonts"*** Page

The "Fonts" page contains three groups, each of which are described:

Apply to *Group:*

Graph Title labeled radio box: Select this option to apply font settings to the graph's title, which always appears centered at the top of the graphing window.

Other Titles labeled radio box: Select this option to apply font settings to the graph's left, right, and bottom titles. The same settings apply to all three of these titles.

Labels labeled radio box: Select this option to apply font settings to the axis labels. The same settings apply to all labels in use in the graph.

Legend labeled radio box: Select this option to apply font settings to the graph's legend.

Typeface *Group:*

Name labeled combo list box (default is Arial): In this list box, you can choose any installed Windows font for the selected text.

Italic labeled check box (default is off): Select this option to have the Graph Control italicize the text.

Bold labeled check box (default is on in the AuvTool): Select this option to have the Graph Control display the text in boldface.

Underline labeled check box (default is off): Select this option to have the Graph Control underline the text.

Size *Group:*

Smart Scale labeled check box(default is on): Check this box to have the Graph Control automatically use smaller type if the size you specify (using the Smaller-Bigger scroll bar) makes the text too large for the available space. If the Graph Control cannot make the type small enough to fit, the text will not display at all. If you do not check Smart Scale, the Graph Control will not attempt to use

type smaller than you specify with the Smaller-Bigger scroll bar. If the text is too large for the space available, it simply will not display.

Smaller-Bigger labeled scroll bar: This scroll bar lets you set the size of type. If Smart Scale is selected, the Graph Control may override your setting to make the text small enough to fit in the graphing window. Each click on the Smaller end of the scroll bar decreases the text size by 5 arbitrary units (to a minimum of 50), and each click on the Bigger end increases it by 5 units (to a maximum of 500). The initial size depends on which type of text you are sizing.

Reset labeled button: Click this button to reset the text size to the default.

Editing the Fonts of a Graph

According to the introductions above, you can edit the font setting for graph titles and other objects. To do this:

- Select the radio box in the **Apply to** group you want to modify its font setting.
- Select the font name, check font styles, adjust font size if desired.
- Click Apply Now button or Ok button. (The difference is that the ***Graph Control*** dialog box will not exit when you click Apply Now button.) The graph will be automatically refreshed.
- If you want to abandon your font settings, click the Cancel button. The ***Graph Control*** dialog box will disappear and no change will be made to the fonts of a graph.

17.3 Copying a Graph to Clipboard

To copy a graph to clipboard:

- Click the right mouse button within the range of a graph to bring up the *Working with Graph* menu as previously shown.
- Release the right button, and drag the pointer to **Copy**, click on this by pressing left mouse button.
- Now you can paste the graph to other Windows applications supporting pictures, for example, Microsoft Word and PowerPoint.

17.4 Saving a Graph to a File

To save a graph to a file:

- Click the right mouse button within the range of a graph to bring up the *Working with Graph* menu as previously shown.
- Release the right button, and drag the pointer to **Save…**. Click on this by pressing the left mouse button. A standard ***Save As*** dialog box will pop up.
- Enter a filename for your graph in the "File Name" text field in the *Save As* window. Select one picture file type in the "Save as Type" combo list boxes. The file will automatically be saved as a picture file. We recommend that you use one of these extensions: .wmf, .jpg and .bmp for the corresponding picture file formats. This extension will facilitate later insertion of the picture file into a MS Word document.

Note: There are tree kinds of picture file types available you can save as in the AuvTool. They are .wmf, .jpg, and .bmp file format types.

- Click the Save button in the ***Save As*** window to save the file.

17.5 Printing a Graph

To print a graph:

- Click the right mouse button within the range of a graph to bring up the *Working with Graph* menu as previously shown.
- Release the right button, and drag the pointer to **print**. Click on this by pressing the left mouse button. The program will print the graph.

18.0 TROUBLESHOOTING

This is the first version of the AuvTool program. Although it has been tested, it is possible that you may encounter difficulties.

Due to potential instability of numerical simulations in some cases, especially for the beta distribution, bootstrap simulation may take a long time or may not go to completion. Although the program provides some error handling, there maybe some unknown fatal errors which occur in few cases.

The following will introduce the possible errors that might happen and the methods to deal with them.

Problem:

The program stops working after you do a bootstrap simulation for a dataset, the reason is often because of the appearance of a fatal mathematical error. In this case, it will be necessary to end program use and start over.

Solution:

Press "CTRL + ALT + DELETE" keys together. A dialog box will appear. In the dialog box, select AuvTool and press the End task button.

Problem:

In some situations, there maybe have some errors in importing Excel ™ files to the AuvTool and the import may not successful. There are three reasons which might lead to the appearance of such errors: (1) the Excel ™ file format is not a Microsoft Excel ™ 97 format; (2) The Excel ™ file you are importing into AuvTool is being used or is open in your Excel ™ program; and/or (3) the Excel file is too large or has some special characters that the AuvTool cannot support.

Solutions:

(1) Save the Excel™ file in the form of Excel™ 97 file format;

(2) Close the Excel™ file in your Excel™ program; and /or

(3) Use the Window Copy and Paste commands introduced in the section of "Data Entry, Importing and Exporting " on page 22 to import the data from the Excel™ file.

Problem:

In few cases, if the sheets in the AuvTool contain a lot of data, when you try to export the sheets to an Excel file, the exporting may not be successful. The reasons are not known.

Solutions:

(1) Export the sheet to a tab-delimited text file, which can later be open in the Excel™ application.

(2) Use the Window Copy and Paste commands introduced in the section on "Data Entry, Importing and Exporting" on page 22 to export data to an Excel™ file.

Other bugs may exist. At this time, the software us provided "at is" and no support is available. We would appreciate if you would notify us of any comments you have or problems that you have encountered by sending email to Dr. Chris Frey at **frey@eos.ncsu.edu** and to Junyu Zheng at zhengjunyu@hotmail.com.

19.0 REFERENCES

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